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A Designer's guide to the evaluation of digital proofs

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A Designer's Guide to the Evaluation of Digital Proofs

by
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CERTIFICATE OF APPROVAL

Master's Thesis

This is to certify that the Master's Thesis of

Eric Lopatin

With a major in Graphic Arts Publishing
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Statement Regarding the Reproduction of:

A Designer's Guide to the Evaluation
of Digital Proofs

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Abstract

Digital color proofs and pre-proofs are used by graphic artists and commercial printers throughout the prepress process. However the prepress process has undergone radical changes over the past decade due to the introduction of desktop publishing and desktop prepress. Alongside of the desktop publishing revolution has come a multitude of new digital proofing technologies for use in this ever changing environment. Technologies including, but not limited to, liquid inkjet, dye sublimation, continuous inkjet, color laser, and thermal wax transfer printers have provided an entire range of color accuracy and price suitability to many of their users. However one needs to be able to understand the practical applications and limitations of these technologies to make a suitable choice for a specific prepress operation or design process. Therefore a handbook for the users of digital proofs has been created for their benefit.

The underlying structure of this handbook is based on the following six chapters. The first chapter, entitled *Communicating with Prepress and the Attributes of Digital Proofing*, contains multiple parts. Firstly, it contains information for the designer in regards to the advantages and disadvantages of all types of digital output devices. It discusses the advantages which digital output devices may or may not have over conventional proofing systems. Additionally, ideas such as the vantages and drawbacks of preproofers and proofers is elaborated upon. Information for this part of the chapter was obtained through questionnaires

completed by, and interviews with print buyers, art directors, and production managers from advertising agencies and prepress providers in the Rochester area. More information for this section of the first chapter was obtained through various manufacturer's literature, printing industry reports and various periodicals.

Chapter One also discusses ideas behind the application of color printers (preproofers) and digital proofers. These ideas address issues which pertain to the application of specific printing and proofing processes to specific phases of the creative and production processes. Additionally, discussions regarding proofing costs, qualities, and production turnaround time may be found in this part of the first chapter. Information for this section of Chapter One was obtained through information found in printing and publishing related periodicals, as well as in manufacturers' literature.

Finally, the first chapter develops a system for the correction of digital preproofs and proofs. Multiple groups of ideas pertaining to the correction of digital output are discussed. Some of these include sections entitled *Digital File Tracking and Identification, Evaluation of Design Elements, Evaluating Colors, Element Positioning, and Element Dimension Adjustments.* Information for this part of the chapter was obtained through the evaluation of previously corrected digital contract proofs and preproofs, as well as the interviews and questionnaires mentioned above.

The second chapter, entitled *Proofing Typography*, displays the many different ways that printing and proofing technologies affect text type and display typography. Using the CD-Rom included in the back of the book, one may view on screen how the following technologies affect type ranging from 3 points to 72 points in size: liquid inkjet, large format liquid inkjet, phase-change inkjet, thermal wax transfer, dye sublimation, continuous inkjet, and dye ablation. Information and samples for this chapter were obtained through printing and proofing system manufacturers and advertising agencies in the Rochester area.

The *Color Primer* and Chapter Three: *Proofing for Imagery and Color*, contain information for the designer which may be applied to proper evaluation of color on color prints and digital proofs. The Color Primer discusses subjects such as color space, the additive and subtractive color theories, and common color measurement tools. Chapter Three then applies some of this knowledge in its discussions of proper lighting conditions for viewing prints and proofs, and different human factors which influence the highly subjective evaluation of all digital color output. Information for this chapter was gathered using graphic arts and printing industry related periodicals and industry-wide books related to color and its reproduction.

The fourth chapter, entitled *Substrates and Digital Output*, educates the designer about the effects on text, imagery, and graphics which occur when creating digital prints and proofs on a variety of papers. Various paper surfaces such as gloss, semi-gloss and matte surfaces are addressed. The affects of colored paper on imagery and graphics are also elaborated upon. Additionally, printing and proofing processes are discussed in regards to the substrates that they accept for output. Information for this chapter was gathered through manufacturers' literature and various industry related books and periodical articles.

The *Proofing Process Supplement* was created to familiarize the designer with all currently popular forms of digital output technology. The process supplement discusses the imaging processes used by the following digital output technologies: liquid inkjet, phase-change inkjet, thermal wax transfer, dye sublimation, continuous inkjet, and dye ablation. Additionally, the supplement contains brief explanations regarding screening technologies. Information for the process supplement was gathered through manufacturers' literature, interviews with prepress providers in the Rochester area, and interviews with technical representatives from the manufacturers of devices which use the above digital, color output technologies.

Chapter Five, entitled *Image Fidelity*, simply illustrates how all of the currently popular printing and proofing technologies affect graphics and imagery. Using the CD-Rom included with the guidebook, the reader may view magnified and normal views of printing and proof sample imagery. Information noted by the reader in the proofing process supplement may then be actively applied when viewing these samples. Information and sample prints for the fifth chapter were gathered from several manufacturers and advertising agencies in the Rochester area.

The sixth chapter, entitled *The Acceptance of Digital Contract Proofing,* discusses a new definition of the contract proof in regards to the evolution of digital proofing. This chapter provides ideas for the designer, art director, and print buyer to realize when considering the use of digital contract proofing. Several questions are raised concerning what requirements a digital contract proof must fulfill depending upon the areas of its application and any agreements between the designer and prepress provider regarding their specific definition of a digital contract proof. Additionally, specific advantages of digital contract proofs, such as their ability to fingerprint a press and/or press run, are discussed. Finally, a discussion pertaining to the education of all users of digital proofing technologies is presented to aid the overall acceptance of digital contract proofing. Information for this chapter was obtained through the extensive interviews of leading technical and product oriented representatives from the manufacturers of currently used digital contract proofing systems.

Many conclusions have been reached with the completion of this guidebook. In brief, the first and most prominent conclusion which may be reached states that the acceptance of digital contract proofing lies within the education of all designers, art directors and print buyers about digital printing and proofing technologies. As the use of digital contract proofing grows, education and interest by all creative professionals will orient them towards their use of digital proofing systems.

The next conclusion which has been reached is that the proper application of color printers and digital proofers is of major importance for the designer due to the added flexibility and rewards which result from the use of digital color output devices throughout the creative and production processes. Another conclusion which may be reached is that the display of proofing and printing process effects on text, graphics, and imagery serves to directly inform the creative professional how these elements may be distorted by the utilized output device. Knowledge gained by the creative professional in regards to these effects helps to answer many questions regarding print or proof quality and proper output device application.

Finally, additional knowledge gained by designers which pertains to proper viewing of all color output, color theories, color measurement, and proofing substrates helps them to better communicate with those prepress and print professionals involved in the production process.

Chapter One: Introduction

Color proofs are an essential part of the link between the design professional and the commercial print provider. Over the past decade color proofs and pre-proofs which are linked to the world of desktop publishing and prepress have evolved to provide both of the above parties with a method of judging the appearance of an upcoming printed project before it arrives at the press. These proofs may be photomechanical, or they may be completely digital.

Today digital proofs are beginning to obtain the high quality needed by those involved with commercial publications. High end systems such as the Kodak Approval generate halftone dots to enable the viewer of a proof to discover moiré patterns, diffuse highlights which appear to be specular, plugging of shadows, and excess amounts of any of the process colors in specific image areas. Aside from the highest quality digital proofing systems, other lower quality and less expensive systems have appeared as well. These systems appeal to the wide range of designers and printers who cannot afford high-end equipment. Several are used as pre-proofs or proofs directly ahead of conventional systems such as 3M's Matchprint.

To be able to use any range of digital proofing equipment in the design or prepress process, one must know the equipment's capabilities, how to evaluate the results of a specific proofing system, and what steps of the reproduction process it can be correctly applied to.

Statement of the Problem

According to the information above, the statement of problem for creating the guidebook entitled *A Designer's Guide to the Evaluation of Digital Proofs* may be divided into the following sections:

1. Which types of verification processes can be applied to the procedures involved with the interconnected areas of design, prepress, and press related applications?

2. What types of color printing and digital proofing systems are best applied to what types of design and prepress operations?

3. How and when should pre-proofs be used by the designer?

4. If a digital proof is intended to be the only method of proofing a job before it arrives on the press, then how will it affect the contractual relations between those involved with the design and its reproduction?

Digital Proofing Acceptance by the Graphic Arts Industry

Ten years ago, proofing methods such as DuPont's Cromalin system were merging into the graphic arts industry with a slow yet steady rate of acceptance by both clients and prepress services. Today these film-based systems have become conventional and customary. However these conventional, film-based proofing techniques are no longer as practical as many users of desktop publishing technologies would like them to be. Currently graphic artists have image manipulation techniques and typographic possibilities which must be observed much earlier in the design process than at the very end, before a press run begins. Digital proofing systems which offer a multitude of image qualities, color accuracy, and price ranges have provided both designers and prepress services with the possibility to economically correcting mistakes before costly films, processing chemicals, and proofing materials are used (Seybold, Color Proofing).

Side-by-side with high end digital proofs are the so called "pre-proof." These lower cost systems have become a practical method of experimenting with layout possibilities which could never have been visualized under the cost of film based proofs. In addition to accommodating creativity, many of these systems let graphic artists test overprints and traps (Hogg, 11). Also, if a design must be approved in more than one office location, remote proofing sites can be set up to save postal or shipping costs and time. Today these are some of the issues of flexibility that digital proofs are offering which conventional methods cannot. In this sense they have become accepted by the graphic arts industry.

However practicality is not the only sense of the industry to which they must appeal. High quality commercial printing demands precise color accuracy, screen accuracy, and image fidelity (Hannaford, 24-26). Digital proofing systems are still battling against these demands. On extremely high cost jobs, the savings digital proofing may provide are exchanged for the safety and trustworthiness a conventional method assures (Hogers, 18).

Although many clients still demand film-based proofs, they are using devices such as the Iris 3024 inkjet printer to complete intermediate proofs (Hannaford, 24-26). This can be especially true when certain jobs require extensive corrections or "rounds of proofing" (Hogg, 12). In addition to these positive qualities, many digital proofing devices share a repeatability factor (referring to color and tonal accuracy) and fast turnaround times which the developing processes, film, and labor requirements of conventional proofs cannot offer.

All of the above facts are currently helping the graphic arts industry to accept digital proofing as either intermediate or contract-based methods of determining what will appear on final press sheets. As both sides of the industry (designers and printers) accept digital proofing, they must also understand the variables involved such as cost, flexibility, and dependability. To do this efficiently, a bridge must be found to connect the designer and commercial printer. As they begin to communicate across this bridge about what happens before a job arrives on or near a press—including checking and correcting proofs and using the proper proofing device at the right point in the creative and reproduction processes—they can also mutually share the benefits of a job well done.

Reasons for Interest

The personal reasons for interest in constructing a designer's handbook for the evaluation of digital proofs are many. Within the past five years it has been observed that desktop publishing has grown into the graphic arts industry through the eyes of both a graphic design and printing student. It has influenced both the creative processes and the production processes. Every graphic artist should have the experience one obtains as a printing student. As the worlds of design and printing persist in merging their attributes through technology one should know as much as possible about both fields of study. The writing and research involved with the completion of *A Designer's Guide to the Evaluation of Digital Proofs* has provided a specific method with which to persist in my own goal of obtaining a growing amount of knowledge about the major aspect which links the arts of graphic communication and its reproduction—the digital proof.

Chapter Two: Background

Correcting and Checking

Perhaps the most valuable knowledge graphic artists should obtain in regards to color printing and digital proofing is the ability to correct and check the results of a pre-proof or proof. In the past many methods of checking and correcting halftone or film-based proofs existed simply on the basis of viewing halftone dots. However only a few digital proofing systems such as the Screen dp-460 or Kodak Approval can provide this extremely high amount of sophistication.

It would be incorrect to state that the lack of halftone dots in the output of other technologies, such as dye sublimation printers or continuous tone inkjets, means that it cannot be checked or corrected during the creative or prepress processes. In fact, continuous tone output as well may be inspected in many ways by the trained eye of a designer, art director or prepress manager. One of the first most important aspects to keep in mind when checking a proof is how the proofing method of choice simulates or distorts final printing conditions (DiNucci, 10-11). This includes the photographic quality effect that continuous tone printers display, over-saturation of colors, loss of certain shades of colors, and loss of detail due to resolution limitations of certain printers. Other factors to be aware of—which may need to be changed—are color casts, mechanical errors, hues and overall brightness of objects or the entire image, sharpness, and the results of any image manipulation which was carried out. Typographic qualities such as loss of serifs and light or heavy character weights should be looked after (Bann and Gargan, 12). Comments for corrections pertaining to any of these should be made by specifying the effect one is looking for—such as, "this apple should not be as red." If observing a digital proof with halftone dots, one can also identify moiré patterns and faulty linescreens. In addition to these observations, one can refer to the color bar printed on many pre-proofing devices and all devices considered eligible for contract proofing. Color bars indicate each process color, two color overprints, and a neutral gray swatch (DiNucci, 12-13). All of the above considerations should be a part of the routine inspection of all digital color proofs by both designers and prepress services.

Characteristics of Digital Proofers: dots vs. no dots

As mentioned in the section entitled *Digital Proofing Acceptance by the Graphic Arts Industry*, digital proofing technology has brought with itself many advantageous qualities into the world of graphic arts. They offer a wide range of image qualities, color accuracy, and affordability. Unfortunately not all digital proofing devices offer the same image characteristics. Only a few systems offer conventional halftone dot imagery. These systems, such as the Kodak Approval, are extremely expensive—approximately $245,000. The question of whether or not digital proofs need to contain halftone dots is the subject of great debate in the graphic arts industry.

However many believe that the factor of "dots or no dots" should be overcome by communication and trust between the creative staff and prepress service. "The true goal of the proofing process is to be able to make predictions of what will happen on press" (Seybold, Color Proofing). It is important to involve designers in the production portion of the job so that they may also learn to compare digital proofs to press sheets. The experience of success during several jobs with digital proofing is the key to overcoming a new technology whether it is similar to conventional methods or not (Hannaford, 24-26).

Another important factor which arises in determining the importance and value of halftone dots in a digital proof is the ever growing technology of stochastic screening. Stochastic screening can be built into the software controlling digital proofers, as in Agfa's CrystalRaster technology, while conventional proofing methods have a difficult time coping with the great number and small size of stochastic dots (Hogg, 13).

Along with all of the above factors and the savings in cost of imaging only one set of films before press-time, the question of whether or not a digital proof should contain halftone dots becomes a secondary consideration.

Applying Specific Technologies to Areas of Production: pre-proofs or proofs

Another highly important factor graphic artists should be aware of is where and when certain proofing technologies should be used. It is important to know the difference between technologies which are accepted as preliminary proofs and those which are accepted as nearly contract or contract feasible proofs. In addition to this knowledge, the different uses of contract proofs and pre-proofs should be noted as well.

The technologies which are most often related to preliminary proofs are as follows:

- thermal wax printers: Tektronix Phaser 220
- electrostatic devices: Efi Fiery and CLC
- desktop inkjets: Tektronix Phaser III and Hewlett Packard DesignJet 650C
- color laser printers: QMS Magicolor

The technologies which may be accepted as contract or near contract proofs are:

- dye sublimation printers: 3M Rainbow
- continuous tone inkjets: Iris 3024
- digital halftone devices: Kodak Approval

please note that the above examples were taken from Hamilton, 60-61.

The above proofing systems are divided into their corresponding groups for a variety of reasons. To begin with, many pre-proofing devices cannot display colors, image fidelity, and typography with a high degree of accuracy or repeatability. Two of the most important factors which contract feasible proofing systems must exhibit are highly sophisticated color management systems and repeatability. Repeatability refers to the repeated display of color quality and accuracy which has been adjusted to match a specific printing process. Color management profiles such as those being created by the ColorSync Profile Consortium enable high-end proofing systems to display extremely high degrees of repeatability and precisely match image colors to specific printing processes (Seybold, Color Management Issues).

As mentioned above, it is important not only for the designer to know which technologies are accepted as which types of proofs, but also to note the different uses of pre-proofs and contract proofs. The main uses for pre-proofs are to judge the effect of an overall color scheme, to check placements of design elements, to check color breaks for spot colors, and to use an image generated on a pre-proofing system as a placeholder in design comps. Some of the main uses for contract feasible proofs are to judge the quality of color reproduction, to check registration and flaws in screening, and precise overall composition size (DiNucci, 4-5).

By becoming familiar with the above and other proper uses of specific digital proofing technologies at certain levels of the reproduction process, the graphic artist will be able to communicate ideas and opinions more efficiently and accurately to prepress divisions.

Conclusions

Knowledge which provides the graphic artist with the ability to check and correct proofs, determine which proofing systems should be used at what stage of the reproduction process, and have confidence in new proofing technologies is an essential part of the communication between prepress service providers and design firms. This knowledge will help to more efficiently complete every cycle of the reproduction process from beginning to end.

Chapter Three: Review of Literature in the Field of Study

Correcting Color Proofs

Bann and Gargan's book *How to Check and Correct Color Proofs* has several helpful sections which can be applied to digital proofing as well as conventional methods. The knowledge included in these sections will help the designer understand the limitations of the proofing and printing processes as well as effectively communicate with the color house what needs to be corrected on a specific proof.

The first helpful section provides the designer with some standard rules pertaining to the mark-up of color proofs. Perhaps the most important notion to abide by when checking proofs is uncertainties should always be explained to the prepress service or color house. If one is not familiar with the definition of a problem or explanation, it is always best to ask questions. Another factor to consider when correcting a proof is to be as clear and concise as possible. The language and clarity of comments should not present confusion to the recipient of the corrections. Ambiguous comments such as, "make greener" which does not explain what type of green to promote or, "—improve magenta" which may mean increase or decrease amounts of magenta, may cause more problems than they solve.

The next helpful section emphasizes the designer's imperative knowledge of which colors and tints may or may not be reproduced using the four color process. Of course it is impossible to recognize every out of gamut color specific to a set of inks or pigments, but Bann and Gargan stress the importance of tint charts and process color simulation systems such as those available by Pantone. These charts and systems show the graphic artist which spot colors or range of colors may not be reproduced using process colors.

Another important section refers to a few typographic practices which designers are advised not to use. The first of which advises to reverse type out of as few colors as possible. Secondly, small process color, serif type on a large, solid color field is extremely tough to proof or print. And finally it is also important to keep thin lines, narrow rules, and fine type in a single color.

A Survey of Digital Proofing System Vendors

Within the document Direct Digital Color Proofing by Charles Hogg, the chapter vendor survey questions addresses where and how certain color proofing system vendors believe their equipment should be used and why proofs may or may not be accepted as contract feasible material. In addition to other questions, the following two are related to the application of specific technologies to areas of the reproduction process:

1. Please explain the benefits of your direct digital color (DDCP) proofing products as an intermediary proof or a contract proof.
2. DDCP is not yet accepted by a majority of customers as contract proofs. Why do you feel that is the case and what must change to allow for broader acceptance?

The two vendors questioned were Tektronix and Screen. In response to the first question, Tektronix stated that its phase-change ink-jet and thermal thermal transfer printers were suitable for preliminary proofs and design comps, while its dye sublimation printers were suitable for pre-film or contract proofs. Screen replied more stringently. Its dye sublimation printers, such as the FP-600S, incorporate color matching softwares which do not exactly match printed page quality. On the other hand, their DP-460 and TC-P1080, which use halftone screening technology produce the high quality standards and accuracy required by contract proofing material.

In response to the second question, Screen was the only participant. The representatives at Screen feel that, "there is a lack of confidence on the part of the printer to believe the digital proofing device can create the same quality of proof as can be made with film." Another reason they believe DDCP is being accepted slowly is that the extreme pricing of high-end equipment is a deterrent to prepress divisions. Although this high-end equipment is more readily acceptable as a contract proof, many prepress services cannot afford to purchase it. The final reason Screen offered for the hesitant acceptance of DDCP is that until the graphic arts industry realizes the increase in productivity and decrease in cost offered by digital proofing, it will not fully embrace a new proofing technology.

Chapter Four: Statement of the Project Goals

The primary goal of this thesis project was to produce a handbook for graphic artists to use during the evaluation of a wide range of color prints and digital proofs. However a more detailed description of project goals is given in the following five statements:

1. To provide the designer with types of verification processes that can be applied to the digital proofing procedures involved with the interconnected areas of design, prepress, and press related applications (checking and correcting proofs).
2. To provide the designer with the knowledge of what types of digital proofing systems are best applied to what types of design and prepress operations.
3. To provide the designer with knowledge pertaining to the technologies behind all widely used color printing and digital proofing output devices.
4. To provide the designer with basic color knowledge which directly relates to color printing and digital proofing applications.
5. To inform the designer how pre-film feasible, digital proofs will affect the contractual relations between those involved with the design and its reproduction.

Chapter Five: Methodology

The methodology for this thesis project may be broken down into the five sections created by the specific project goals on the previous page.

1. To provide the designer with types of verification processes that can be applied to the digital proofing procedures involved with the interconnected areas of design, prepress, and press related applications (checking and correcting proofs).

Methodology:

In response to the proposed problem of providing designers with methods to check and correct preproofs and proofs, a system of corrective symbols and ideas was assembled (in the first chapter). Within the system, several graphic symbols are used for design element adjustments and commentary on general color problems. In addition to these graphic symbols, multiple groups of ideas which address areas such as digital file tracking, evaluation of design elements, evaluation of colors, and production notes have also been included in the system. Overall, design adjustments and corrections regarding any of these areas have also been marked as being applicable to preproofs and/or contract viable proofs.

Information for the ideas and graphic symbols included within this preproof and proof evaluation system were obtained by evaluating digital output from various prepress providers and advertising agencies in the Rochester area. A list of these agencies and the personnel contacted within them appears below. Note that these agencies were used and questioned regarding many other areas of information which appear throughout the guidebook.

Prepress Providers

Quadra Color Express	Tom Pierce—Prepress Manager
Canfield and Tack	Andrew Kappi—Prepress Manager
Rochester Empire Graphics	John Meyer—Prepress Manager

Advertising Agencies

Rumrill Hoyt (Saatchi & Saatchi)	Karen Carr—Print Buyer
Hutchins, Young & Rubicam	Tom Barton—Art Director
Wolf, Winterkorn, Lillis	Dave Kochesberger—Print Buyer

2. To provide the designer with the knowledge of what types of digital proofing systems are best applied to what types of design and prepress operations.

Methodology:

In response to the above problem, information was gathered regarding the most current usage of all different types of proofing technology mentioned throughout the guidebook. This information serves to explain which types of proofing technologies are best applied to which steps of the creative and production processes. It also explains which technologies are considered to be more useful as preproof oriented systems and which are considered to be more useful as contract proof oriented systems. This information was retrieved from various industry-wide periodicals and several interviews with leading technical and product oriented representatives from the manufacturers of the following corporations: 3M, Fuji, Kodak, Optronics, IRIS (Scitex), and DuPont. A list of these contacts and their employers may be found in the methodology section of the sixth problem below.

3. To provide the designer with knowledge pertaining to the technologies behind all widely used color printing and digital proofing output devices.

Methodology:

Using manufacturer's literature as its source, the output process supplement, found directly ahead of chapter five, explains how each of the most popular, currently used proofing technologies work. In addition to the explanation of how these processes work, over eighty different samples (found on the CD-Rom) display how each proofing process affects text type, display type, vector based graphic art, and color imagery.

4. To provide the designer with basic color knowledge which directly relates to color printing and digital proofing applications.

Methodology:

In response to this problem, the color primer and third chapter were created. The color primer serves to inform designers about color issues directly related to color printing and digital proofing. Issues such as basic additive and subtractive color theory, color space, color gamut of the process inks, and lighting color balance are discussed. Ideas for the subject matter in the color primer were suggested by the answers to multiple questionnaires handed to the prepress providers and advertising agencies in the Rochester area. More specific, technical information for the color primer was gathered through research in up-to-date, industry-wide periodical articles and textbooks.

The third chapter addresses the above problem through several discussions which pertain to the proper lighting conditions required for viewing preproofs and contract proofs—in the studio, at the prepress provider, and during the final press run. Other discussions include elaboration upon the degree of subjectivity involved in the viewer-to-proof evaluation process. Human factors which arise such as memory colors and design element influences are discussed. Finally, the third chapter informs the designer about the limited process color simulation of spot color matching systems. Ideas for the subject matter in the third chapter were also suggested by the answers to the questionnaires handed to Rochester area printing and creative professionals. Technical information for the third chapter was gathered through research in periodicals and textbooks.

5. To inform the designer how pre-film feasible, digital proofs will affect the contractual relations between those involved with the design and its reproduction.

Methodology:

The information which answers the above, evolving question is contained in the sixth chapter. As mentioned earlier, several interviews with leading technical and product oriented representatives of the manufacturers of digital proofing systems occurred. The bulk of the information and ideas for the subject matter of the sixth chapter originate from these interviews. The manufacturers and their representatives are listed below.

Manufacturer	*Representative*
3M Corporation—Rainbow	Nick Patricci
Kodak—Approval	Wick McCaleb
IRIS, Scitex—Realist and 30xx Series	Stan Rosen
Fuji—FirstLook	Richard Black
Optronics—Intelliproof	Andy Katz
DuPont—Digital Waterproof	Martin Redding

In the sixth chapter, a new definition of the contract proof is stated for the designer. Ideas and questions (pertaining to this new definition) which are involved in the agreement between the creative professional and print provider are stated and raised respectively. Multiple discussions resulting from questions regarding the appearance of and physical qualities of contract proofs help orient the designer towards his or her acceptance of digital contract proofing. Additionally, methods of obtaining experience with digital contract proofing equipment are elaborated upon. Finally, the sixth chapter helps to focus the designer on the idea that the key to the industry-wide acceptance of digital contract proofing is user education.

Chapter Six: Results and Conclusions

Conclusions

There are many conclusions which may be reached with the completion of this guidebook. Throughout the compilation of the guidebook's practical knowledge for the creative professional, the following conclusions have been reached based upon the information contained in each of the chapters.

I. The introduction of a color printing device into the creative process lends its users greater design and creative flexibility throughout the creative and production processes.

II. The use of consistent corrective marks and evaluative comments during the correction of color prints and digital proofs is a basis for excellent communications between the creative professional and prepress provider.

III. All printing and proofing technologies display and/or distort text, imagery, and graphics differently. The creative professional who is knowledgeable about which technologies display which printing characteristics will have a definite advantage in the desktop publishing working environment.

IV. Use of color printers and digital proofers by all design groups and advertising agencies is increasing daily. Therefore, designers must be educated about their advantages, disadvantages and proper applications based on output device cost and quality. Ultimately, the design firm which is adept at using the proper color output technology will be aware of many of the same variables dealt with by prepress providers. A greater, proper awareness of color output variables helps to ease communications between creative professionals and prepress/print providers within the desktop publishing working environment.

V. Digital proofing is being successfully used at all levels of the graphic arts industry. Most importantly, designers *must be educated* about the new definition of a contract proof to sway them towards the use of digital contract proofing—and to keep them oriented towards the cutting edge of proofing technology. Eventually, they may be printing a contract proof more often than the prepress provider.

VI. More digital contract proofing technologies have been introduced into the marketplace in the past *five* years than conventional proofing technologies have been in the past *twenty* years. In result, the acceptance of digital contract proofing will be slowed by this factor. Furthermore, the acceptance of digital contract proofing is inversely related to the quality of the reproduction at hand—acceptance will be slowed most in the production of high quality printing. Meanwhile, the greatest acceptance of digital contract proofing lies within the creation and production of low quality printing.

Recommended Areas of Further Study

Within the guidebook, there is much information pertaining to the use of color printing and digital proofing by the designer which may be elaborated or expanded upon. Firstly, as the acceptance of digital contract proofing is continuously growing, in-depth studies regarding the areas of its acceptance is strongly recommended. Next, new printing and proofing technologies are continuously developing. Research regarding these new technologies is also recommended. Another area which may be studied in depth is the increasing use of digital remote proofing. Currently, remote proofing has been limited by the data transfer capacities of the Internet and other worldwide networks. As the transfer of large amounts of data becomes less costly, the use of remote proofing will become more and more common. Therefore, research related to the use of remote proofing and the Internet is highly recommended. Finally, research regarding the use of new screening technologies in digital color output devices is also recommended.

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Appendix A

A

Designer's Guide

to the

Evaluation

of

Digital Proofs

by Eric Lopatin

A Designer's Guide to the Evaluation of Digital Proofs

by Eric S. Lopatin

INFINITE PRESS
Somewhere near
the end of infinity.

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Preface

As a creative professional in the age of desktop publishing and electronic prepress, it is a necessity to become familiar with the many elements of printing and prepress technology. These elements range from scanners and software which enable graphic artists to manipulate and tweak imagery, to electronic pagination programs such as QuarkXPress and Adobe Pagemaker, to output devices which make it possible for designers to view their creations on paper. In a visually based community of graphic arts, all of the above are extremely important components associated with the design process. As this guide book will indicate, the most important collection of elements mentioned is the variety of available digital proofers.

Digital output devices can be currently divided into two major groups (Benham, 10). The first group are those output devices creating prints which simply show the designer a tangible design composition. With these prints, one may observe element positioning, text flow, pleasing however non-accurate color, and the overall fidelity of the layout. Many of these color printers also provide the technology to output on several substrates such as simulated vellums, recycled papers, slightly textured papers, and several other coated or uncoated stocks. For all intensive purposes this group of printers create *preproofs* which are not contract viable. They do not provide a print buyer or art director with an accurate means of determining how a final press sheet or printed product will appear. For the purpose of simplification, this guide book will refer to all of the devices which produce *for position only* (FPO) proofs as *color printers* or *FPO proofers.*

Although color printers do not produce contract worthy output, they do play a very important role in the creative process. With generally less expensive consumables, color printers allow the designer and prepress provider to circulate several versions of the project at hand. Repeat prints which display new color schemes, graphic element shifts, text flow changes, and overall composition changes may be output without the concern of extremely expensive overhead costs. Other uses of this color printing technology can even enable design agencies to produce the end product of short run, on demand jobs such as those which may be completed with duplexing color copiers or the large format printing required for exhibition posters. The capability of creative professionals to use color printers in-house for these purposes has involved the entire graphic arts community in an era of newly wrought interaction with prepress providers and adaptations to new technology.

The second group of digital output devices may be referred to as contract viable digital proofers. As with the previous group a simplified name of *digital proofers* will be adopted for the guide book. These devices, often costing much more than color printers, are those which provide all that a preproof displays, coupled with the exhibition of accurate color and, depending upon the device, true halftone dots and screen angles. The output of contract viable digital proofers is not yet accepted by the entire graphic arts industry as a worthy display of the final printed product. Conventional proofing methods such the 3M Matchprint or DuPont Cromalin are still the industry's most widespread means of predicting the qualities of a press sheet. However these conventional methods are now losing out to the adaptability of contract viable digital proofers. With a digital proofer it is possible to more accurately compensate for press characteristics, substrate qualities, and other printing process attributes. As more and more members of the graphic arts community begin to adopt and realize the advantages of digital proofing as a means of judging the color accuracy and appearance of what will appear on press, digital proofers will gain the trust that conventional methods have earned over the years (Benham, 11).

To better orient the reader with the different chapters of the guidebook, brief explanations of the subject matters in each chapter may be found in the introduction. In addition to these explanations, a glossary of useful terms has been constructed which contains frequently used terminology related to the applications of printers and digital proofers.

Introduction

Until the 1990s, creative professionals and print providers have been able to work in their separate fields without crossing over each other's paths of interest too often. A design was created, the type set, photos shot, and mechanicals constructed by graphic artists who would then pass the job on to prepress and press technicians to proof and print the final product. The bulk of communication surrounded the proofing process when art directors and print buyers alike would approve the proof representing what would occur on press. However present technology has created the need for increased communications between these two groups of professionals. Due to its ability to give the graphic artist more choices concerning typography, imagery, color, and design format, publishing technology requires a stronger tie between those who create with it and those who produce with it. When elements of a job are changed several times, by either artists or producers, a streamlined form of communication must be adopted in order to efficiently move through all stages of a single project.

Today any exchanges of information during the design process, including but not limited to composition, image editing, substrate determination, and printed format may all be verified or simulated through some form of digital color proofing. Color printers and digital proofers, as mentioned in the preface, exist for various types of applications and economical circumstances—remember, that for purposes of simplification in this guidebook *color printers* are those output devices which do not produce contract feasible prints, while *digital proofers* do.

Low cost *inkjet* and *thermal wax transfer* printers immensely aid the design process by providing the artist a tangible design composition in the critical beginning stages of a project. Meanwhile middle to high level *inkjet* and *dye sublimation* proofers may be used to produce a proof which is viewed directly ahead of the final contract proof. And high end digital proofers, such as those that utilize the dry laser process, can be used as final contract viable proof material upon which to sign off. With numerous grades and processes of proofing it is imperative that anyone who uses them be familiar with their qualities, costs, proper application, and technical details.

Information about all of these areas has been grouped and made available through this guidebook. The groupings can be referenced with the visual guides to color printing and digital proofing following the introduction. Furthermore, each group has been given a small summary in the following paragraphs in order to familiarize the reader with the subject of proofing.

Chapter One: Communicating with Prepress and the Attributes of Digital Proofing

This first chapter of the guide book is broken down into four different sections. All of them encompass some aspect of correcting prints and proofs, using specific correction marks to aid communications with your prepress provider, advantages and disadvantages of contone and halftone proofing, and workflow regarding digital color output. While discussing the correction of prints and proofs, topics such as the application of *color proof reader's* to areas of the output and their use are covered. Also, correction of the more accurate or specific information displayed on digital proofs are compared and contrasted to correcting color prints.

There are several advantages and disadvantages to both contone and halftone proofs. Advantages such as identification of moiré patterns on halftone-based proofs or cost efficiency of contone proofs are discussed. Disadvantages such as high cost per proof and the lack of image and/or spot color accuracy are applied to either type of output device.

With application to all types of prints and proofs, the first chapter will also cover standard correctional procedures during communication with a prepress provider. Factors such as time restrictions, amounts of proofs and prints evaluated during the design process, setting up frequently used color proof reader's marks, and avoiding confusion related to these marks are addressed.

Chapter Two: Proofing Typography

Text and display type may undergo several changes during the design process. Color printers and low lost digital proofers have enabled graphic artists to experiment with type by providing a visual approximation of the final product. Each different printer or proofer displays type differently. It is important for the designer to realize which output devices affect type in which manners. Attributes such as sharpness of small text type, effects of output resolution on text weight, and text spot color inaccuracies will be discussed.

A Color Primer and Chapter Three: Proofing for Imagery and Color

In this chapter, factors which affect imagery, spot colors, and duotones are covered.

Some of the output device factors to be considered which affect process color imagery include the proofer's image consistency and repeatability, and the proper maintenance of all output devices. In addition to these factors, a section regarding how specific output device processes can affect *color gamut* may be found here in the Color Primer. This is important due to the fact that many color output devices have color gamuts which far exceed those possible using the four process colors: cyan, magenta, yellow and black.

Besides the above considerations, an important section on proper viewing conditions discusses the significance of correct lighting at both the design studio and prepress house. Because viewing printed imagery is a subjective procedure, other factors which affect the viewer will also be analyzed. These factors range from the adaptation of the viewer's eyes, to which colors in the composition need to be pleasing or accurate, to how long the viewer has been awake before viewing a proof and press run during night hours.

Spot colors are another essential topic to be explained in regards to color proofing and printing. With any type of digital output device, spot colors must be represented by the use of four process colors. This usually leads to *simulated spot colors* which do not match their Pantone or solid color counterparts. It is important for the designer to realize when this occurs and with which printing and proofing processes it occurs most noticeably. Simulated spot colors also affect the color quality of computer illustrations which use blends and vignettes. Circumstances which lead to miss matched spot colors and remedies to the problem are discussed.

Chapter Four: Substrates

In this chapter the use of recycled papers and various mixed substrates in modern design is addressed. Using an assortment of papers with different surface qualities leads to the enhancement or loss of image quality and color accuracy. Many contemporary output devices accept several substrates. It is imperative that the graphic artist realize the differences in image fidelity that occur when printing or proofing upon the actual substrate upon which the final product will appear. Variances in dye absorption, image sharpness and clarity, as well as color intensity variations may occur on different types of coated or uncoated paper. In regards to subject matter, the designer also needs to realize what types of images and subject matter may or may not be feasible to view by means of printing or proofing on final substrates. For instance, overall dark imagery (*low key*) tends to darken even more on uncoated papers. While light images (*high key*) may actually lighten on high gloss coated paper due to a lack of dye absorption. An explanation of these variables will enable the creative professional to avoid pitfalls related to viewing proofs and prints on a job's final substrate.

The Proofing Process Supplement and Chapter Five: Image Resolution and Fidelity

Digital proofers and printers produce various resolution prints with several different technical processes. These processes directly affect the visual fidelity of a specific printer or proofer's output. Image characteristics which may be altered by technical processes include sharpness of image element edges, clarity of small details, loss of highlight details, plugging of shadows, and color or hue shifts.

For example, dye sublimation printers often display a loss of image sharpness due to their continuous tone process. Many thermal wax printers simply are not able to reproduce specific pastel colors. Large format proofers using stochastic screening do not produce high resolution output, but reproduce a formidable color gamut. Most of the cited proofing process attributes which affect image fidelity occur with FPO proofers. However some occur with high-end digital proofers. It is important that the graphic artist realizes which proofing processes entail which output effects.

Chapter Six: Contract Feasibility

At the end of the design process several crucial judgements are made pertaining to the final form of the job at hand. A contract proof must make the decision to go to press a confident one. With high end digital halftone proofers and inkjet proofers, going to press with a digital contract proof is possible. Having confidence in both the prepress provider and the proofing process has enabled many creative professionals to make the switch to completely digital prepress.

In the sixth chapter, high end digital proofers such as the Kodak Approval and expected devices from Konica and Polaroid are considered in different production situations. While all the digital proofers mentioned in this chapter have been used as contract viable output devices, some of them work best in a *closed loop system*, while others are feasibly used in an *open loop system*.

In a closed loop system, a single print and prepress provider works on all parts of the production process. The prepress division has the ability to scan artwork, create preproofs, and output film (if necessary) and contract proofs. These proofs are then taken to press by the press oriented division of the provider. In this system, digital proofers may be used to output contract viable proofs by calibrating the proof directly to the in-house press. Therefore more accurate halftone dot proofs may not always be required because there exists such a direct relation between proof and press. In other words there are fewer variables, such as color calibration and *press attributes,* to address.

In an open loop system the prepress provider does not have a direct link to the press(es) that the job will be printed on. While the prepress division may scan artwork and output film and the contract proof, it cannot always address all of the variables which exist between the proof and press. It is best that a strong relationship exists between the printer and prepress provider in order for both to gain experience working with each other's equipment. However if such a relationship does not exist, then a much more dependable proofing system should be available for the client's "confidence factor." In this case a dependable digital proofing system would be one that could adapt to as many of the known press variables as possible. In most all present circumstances, only halftone dot capable digital proofers have been accepted by print buyers and art directors as high enough quality for an open loop system.

Another aspect of the confidence factor related to digital proofing is its ability or inability to be compared with conventional proofing systems. This is just one notion in the sixth chapter which introduces educational ideas to aid the creative professional in adapting to digital contract proofing. Questions are raised regarding the merit of producing both digital and conventional contract proofs for singular or multiple jobs. The addition of information related to technical aspects of digital contract proofing such as comparisons of proofer and imagesetter engine similarities and screen angle variables will also help to ease the designer's mind as one shifts into the realm of digital contract proofing.

Beneath all the ideas and descriptions of the introduction lies the true purpose of this guidebook. In a world where desktop publishing has brought the creative professional closer to prepress and print production, a bridge needs to be constructed to close the final gap which still exists in between the two. Because digital proofing is a direct link which pulls designers into the production phase of graphic arts, it becomes a building block for such a bridge. However digital proofing and color printing come in many different shapes and forms. How are newcomers to familiarize themselves with fresh developments in proofing technology? What will lend them useful information regarding the application of all different types of this technology? These questions are those which are addressed with the facts and ideas presented in, "A Designer's Guide to the Evaluation of Digital Proofs."

Chapter One

Communicating with Prepress and the Attributes of Digital Proofing

Chapter 1: Communicating with Prepress and the Attributes of Digital Proofing

Section 1: *Advantages and Disadvantages of Digital Proofs and Color Prints*

ADVANTAGES AND DISADVANTAGES OF ALL DIGITAL PROOFING TECHNOLOGIES

All proofing systems, whether conventional or digital, are different. They display imagery, text, and graphics in their own manners by using several different technologies. In the past, conventional systems have provided the highest quality in relation to all of these three major parts found in a printed piece. This is because they could only address one aspect of the production process—the stage of approval via a contract proof.

Today, color prints and digital proofs are addressing both the contract proofing stage of the production process as well as several other areas. They possess the ability to produce tangible evidence for the user, be it a designer or prepress technician, from the beginning of the design process all the way to nearly the end of the production process. However, to use printers and proofers at the correct point in the creative or production process, one needs to know how to apply which output technology to which stage of the creation of a printed piece. The first step in the correct application of color printers and proofers is to realize their overall advantages and disadvantages, as well as more specific pros and cons which belong to the low, middle or high-end range of all color output devices.

The general advantages and disadvantages of digital color output devices may be found in the following list of items. Each item has a brief explanation of how the advantage or disadvantage relates to the creative or production process. Note that advantages and disadvantages specific to proofing processes may be found in the Proofing Processes Supplement provided at the beginning of the guidebook.

Advantages

Greater Accessibility During the Approval Process

During the entire process of creating a printed piece, involving the design process and production process, digital proofers are now giving both designers and pre-press providers the ability to output tangible evidence of the current project. Due to the sheer number of different printing or proofing technologies and their availability, there is almost always a color output device which fits the budget or quality requirement for the user. There are color printers which start at under $1,000 which may be economically applied to the creative process, while certain proofers may cost in excess of $245,000 to be used by prepress providers. Whatever the output device, each serves the purpose of showing a design on paper for approval by the designer, art director, or print buyer. In contrast to the single area which conventional halftone proofing systems apply, the contract proof, color printers and proofers have a great advantage due to their numbers and ability to produce color output at any stage of printed piece creation (Hogg, 11).

Speed

All conventional proofing methods require some form of film as a key element to reach the end product of a halftone-based contract proof. The time required to both produce film and the resulting conventional proof may take between one and eight hours (Dennis, 95). The time it takes to print almost any quality of digital proof or print can be as fast as one minute. The highest quality proofs, such as those which are output by the Kodak Approval or Iris Realist 5015 may take up to thirty minutes—still just a fraction of eight hours.

Cost of Consumables

The cost of consumables for digital proofs and prints is also just a fraction of what may be required for conventional proofing supplies. For the design studio which chooses to acquire an in-house printer or proofer, the cost of toner, special substrates, wax crayons, or *color transfer rolls* may be as little as $0.50 per letter-sized print. Even some of the highest cost materials may only produce an expense of $9 per tabloid print. This savings in cost also applies to many prepress providers using high-end inkjet proofers such as the Iris Realist or DuPont Digital Waterproof. For the prepress provider, the total cost-per-print resulting from consumables may be as little as $0.85 per letter sized print or as much as $18 for a tabloid print from a digital halftone output device. These costs for both the design studio and prepress provider are still much less than the $30-$50 consumables cost attached to a conventional proof created with processed *carrier sheets* and specially made proofing *base* sheets. (Hogg, 18-19) (Heid, 128-129)

Proofing Occurs Before Films are Made

In a production workflow using conventional proofing devices, proofs may only be made after the films for the current project have been output from an imagesetter or created otherwise. If the films are incorrect, according to the proof, or they obtain scratches through mishandling, new films and a new proof must be produced. As mentioned above, both films and a conventional proof(s) are not inexpensive. They also require the added costs of expensive machinery and chemical processing. Within a workflow incorporating digital proofing throughout the creative and production stages, digital prints and proofs may be made before costly films are output.

Remote Proofing Sites

Remote proofing is an advantage which is inherent to color printing and digital proofing technologies. Due to the *repeatability* of most mid-range and high-end digital color output devices, the digital files which constitute a graphic layout may be proofed on one digital proofer, while the same files are uploaded to the client (for example) for proofing on the same digital proofing system at a different geographic location. So long as both machines have been callibrated to the same degree of standards required by the prepress provider and/or print house, the proofs will be the same. This strategy is of extreme importance when the client needs to print the current project at more than one location around the world, or when the design needs to be viewed by a similar client with more then one office or studio. Remote proofing may not only take place with mid-range to high-end proofers, but also with lower quality color printers. As the output of these lower quality machines is most often used for the purposes of making design adjustments, color callibration is not of major importance. With the same color printer in two geographic locations, two designers or the designer and client may still view the same color output without the inconvenience of costly express mail packages (Dennis, 76).

THE CONVENTIONAL PROOFING BOTTLENECK

The time it takes to create the films and assemble a conventional proof has become a bottleneck in the digital prepress workflow. With the use of digital contract proofing, the hours it make take to assemble an analog proof are shortened drastically. For example one contract digital proof can be made in as little as twenty minutes on the Kodak Approval (Dennis, 79). Of course the ultimate removal of the conventional proofing bottleneck occurs in a *Computer-To-Plate* (CTP) workflow. In a computer to plate prepress system, films are never created, and the digital file is imaged directly onto plate material. In this scenario, digital proofers are ideal, due to the fact that they do not require film output as an essential part of their creation.

Elimination of Imagesetter Variables in a CTP Workflow

As mentioned above, in a computer-to-plate digital prepress system, films for the creation of plates or conventional proofs are not made. With digital proofing in a CTP workflow, all of the variables created by imagesetters may be eliminated. Variables such as film tension inside of the imagesetter, which may cause misregistration amongst film separations may be ignored. When the tension of the film being spooled through an imagesetter changes, the area of the film to be imaged is skewed slightly, therefore skewing all of the dot patterns burned into it by the laser. Skewed dot patterns on one of the four *process color separations* and not on the others will cause a misregistration of dot patterns and graphic elements when the films are placed on top of each other.

Other imagesetter prone variables such as laser intensity, film processing, or proper imagesetter and developer maintenance may also cause inconsistencies in film output. If the laser of the imagesetter has degraded in intensity due to focal problems or lifespan, the density and darkness of the imagery being exposed onto film will loose quality. If chemicals in the processor are not replenished on time, imagery on the film will also be adversely affected. All of the above variables influence the quality and consistency of film output which may affect the final printed piece and may be eliminated through digital proofing and a CTP prepress and printing system.

Registration

Misregistration of color imagery is almost never a problem with color printers and digital proofers. When an image is out of register (*misregistration*), whether it is on a proof or final printed product, one of the process color images has not been perfectly aligned with the others. Only the correct alignment of all four process color images will produce a high quality, full color printed piece. Misregistration does however commonly appear on conventional proofs. All conventional proofs require four laminate overlays, each with one process color image, to be registered by the eye of a prepress technician for completion. A large margin of human error is eliminated by a printer or proofer which precisely aligns the proofing substrate for the imaging of all four process color layers.

Press and Printing Variables

Every printing process and press involves different amounts of dot gain, different substrates, ink types, and other press-specific conditions. When using conventional proofing methods, only a few press variables may be taken into account during the proofing process. In addition, the amount of possible compensation for these variables is often not enough to completely adjust proof image quality for the printing process. Digital proofers are controlled by callibration software which enables the user to more accurately adjust for dot gain, color shifts due to substrate color qualities, ink or dye color gamuts, and printing processes such as stochastic screening which may not be proofed with conventional methods.

Processes such as stochastic screening may not be proofed by conventional methods due to the dot sizes which are used to create imagery. These dots are so small, in comparison to regular sized halftone dots, that they cannot be resolved by the materials used in conventional proofing methods.

SUBSTRATES

There are hundreds of different substrates which one may choose to print a graphic design. However, most conventional proofing systems only use a few select substrates on which to proof. These substrates are almost always different grades of white which are engineered to generically simulate the varying degree of whiteness found with only the most common paper qualities—newsprint, mid-range stocks with a varying degree of brightness, or highly whitened commercial stocks. Many digital proofers and color printers are able to output imagery on a variety of substrates. Anything from white paper to transparency materials to recycled and texture papers are possible. (Hogg, 21)

Disadvantages

FINAL FILM INTEGRITY

It is estimated that only the top 1,000 printers in the United States use or have the economical resources to use Computer-To-Plate technology with offset lithography (Prince, 1996). Those who do not use CTP, still use imagesetters and films to produce printing plates. One disadvantage of digital contract proofing is that if the film which is output is mishandled, any scratches or fingerprints which appear on film will obviously not appear on the digital proof. However mishandling is easily avoided by exercising care and proper packaging during the transportation of films from area to area or via shipment.

Raster Image Processor Differences

A raster image processor (RIP) and its screening software determine the dot shape and screening characteristics which make up the halftone screens which appear on imagesetter process color separations (films). Every RIP images halftone dots and patterns differently than another. For example, the RIP found onboard a digital proofer is highly likely to be different than the one which will create the films for the same job. This means that differences will appear in color consistency and image fidelity when both the proof and final printed piece are placed side by side. Even if the digital proofer produces halftone dots, the dot patterns will still not exactly match those found on the films for the same job. However, most color shifts or differences in image accuracy may be adjusted to match a press sheet due to the high quality of color callibration software available for use with most contract viable digital proofers.

Digital File Corruption

With any digital prepress workflow, the integrity of digital files is of the utmost importance. If an image file or graphic file becomes altered unintentionally or deliberately, colors, file formats, design element spacing, or any graphic characteristics of a design may cause problems. Likewise, if a digital file is proofed and its data is altered thereafter, then any subsequent proofs or films created with the same digital data will produce different results. However, alterations in digital data may be easily avoided by careful trafficking of digital files and their locations.

Specific Advantages of Preproofs and Highend Contone Proofs

There are certain color printers which create output which is strictly considered a preproof for design and layout adjustments. Because of their lack of sophisticated color control software, variations in color accuracy deem them only useful for this purpose. These color printers are considered to be low-end preproofers. Although they do not reproduce color accurately and/or lack fine image detail, they do have several advantages for in-house design studio use. One of the most important advantages they carry is their ease of use. This makes them ideal for first time buyers and design studios who are just beginning to tackle digital pagination and output. In addition, most easy to use printers have the added benefit of simple maintenance requirements.

Another major benefit which is inherent to low and mid-range color printers is their cost of consumables and so called, "cost-per-print." A letter sized print on a color laser or thermal wax printer may only cost from $0.50 to $0.75 cents. Along with an average low cost-per-print, comes the speed at which one may produce a full color print. Color laser printers are often the fastest, however inkjets, dye-subs and thermal wax printers are not far behind. One may only need to wait as little as 90 seconds or up to eight and nine minutes (Heid, 128-129).

In addition to the above advantages, the previously mentioned concept of remote proofing has become a major benefit of the digital printing revolution. Even the most cost effective color printers may still be used for remote proofing—thus saving time and mailing costs for the design studio with international clientele or with several offices working on a similar project.

As one moves upwards from low-end preproofers, mid-range and high-end continuous tone proofers also have specific advantages. Many dye sublimation printers have the ability to simulate traps. Trap simulations lend the art director or knowledgeable designer a good idea as to whether or not a computer illustration will show paper color in between differently colored illustrative objects. Or whether or not colored type on a dark background will create similar, unwanted results (Dennis, 78).

Another advantage, which is common to high-end continuous tone inkjets such as the Iris Realist, is available software which simulates halftone dot patterns on a monitor. The halftone dot patterns which are seen on screen represent the actual halftone dots which are to be imaged by the correlative imagesetter. Thus, moiré patterns *may* be detected before final films are produced for platemaking (Dennis, 80).

Specific Disadvantages of Preproofs and High-end Contone Proofs

There are only a small number of disadvantages to preproofers which are applied to the correct area of the creative or production process. In regards to low-end preproofers, color consistency is a difficult attribute to attain during the creative process. Color accuracy and consistency may vary as much as print to print differences or as little as the time related to consumable life cycles. However, as long as the designer knows not to trust the color viewed on low-end preproofers, these machines are extremely useful for beginning design rough drafts.

Also found in the low-end range of color printers is the disadvantage of limited availability of color correction software. Due to the lack of repeatability and color consistency in low-end color printers, color correction software is often not practical. Another disadvantage regarding color and low-end to mid-range printers is their printable color gamut. The range of colors which may be created by the process color dyes or wax cartridges in these printers often does not correspond with the color gamut printable by printing inks on press.

The final disadvantage inherent to continuous tone preproofers is a lack of halftone dot patterns similar to those which appear on press. However, when correctly applied to the creative and/or production process, the continuous tone output from these printers is usually not created for the purpose of contract viable output. And those high-end continuous tone proofers which are beginning to be accepted as contract proofs are the few which have sophisticated color callibration software and unprecedented repeatability.

Specific Advantages of Halftone Based Digital Proofers

Perhaps the most beneficial traits of halftone based digital proofers is their ability to display halftone dot patterns which have been highly adjusted to compensate for *press attributes*. The halftone dots on these high-end proofers represent press and printing process dot gain, ink contamination, ink color gamut, and *color overprints*. Additionally, the appearance of halftone dots and the proofing process enable reflection densitometry testing to be performed on halftone based digital proofs. For more information on reflection densitometry, see the *Common Color Measurement Tools* section of the *Color Primer*. Another essential characteristic which halftone based digital proofs display is moiré patterning. So long as the imagesetter and proofer in a non-CTP prepress workflow have been callibrated to consistently produce moiré patterns during testing, then the repeatability of both devices will assure the accurate display of any patterns during the approval stage of a contract proof. Within a CTP workflow, no films are produced. The callibration issue lies between the front end of the digital press, its press attributes, and the digital proofer. The CTP workflow eliminates one very large group of variables—those associated with the imagesetter. For information regarding these variables, refer to the above section entitled *Elimination of Imagesetter Variables in a CTP Workflow.*

Another important advantage which the output of all halftone based digital proofers have is familiarity with the pressman. The pressman's familiarity with and ability to interpret halftone dot patterns in regards to adjustments on press are far superior to those used with the interpretation of continuous tone proofs. A final advantage with certain halftone based digital proofers is their ability to use the actual substrate upon which the job will be printed. This as well helps the prepress provider and print house to properly judge color issues in regards to substrate brightness, color, and surface quality.

Specific Disadvantages of Halftone Based Digital Proofers

There are very few disadvantages to high-end halftone based digital proofers. The most obvious being initial cost for the prepress provider and cost-per-proof for the client. As mentioned earlier the initial cost for the prepress provider may be as much as $245,000. However the cost-per-proof for the client is no higher than with conventional proofs. Although high-end proofers are more costly than other digital proofing systems in regards to output, they may still be less than conventional system costs.

The other major disadvantage of these high-end systems is the size of the output they produce. Proofers such as the Kodak approval system will only produce a proof with "Super B" dimensions. This size entails the display of a full bleed tabloid page but options to expand beyond are only now being addressed in future models.

Section 2: *Ideas Behind the Applications of Prints and Proofs*

The General Application of Digital Prints and Proofs

In addition to knowing the advantages and disadvantages of color printers and proofers, there are several comprehensive ideas to keep in mind when determining the correct application of any color output device. The first additional idea shows which color printing and proofing devices are currently being used at which stage of the creative or production process. To do this, the following chart (fig. 1) illustrates stages during the creation of a printed piece in which color printers and proofers may be efficiently applied. It indicates the color accuracy and repeatability, as well as general costs-per-proof which may be expected when working with digital color output devices.

It is said that by the year 2000, 45% of all digital proofs will be output by the designer during the creative process (3M, A Guide to Color Proofing, 6). This suggests that many proofing processes will make their way into the creative stages of the final printed piece. This goes along with the idea that the earlier in the creative or production process a proof can accurately predict color, the better. However, note that at this point in time, there are only a few popular proofing processes which have been considered worthy of displaying accurate color—those which are considered contract viable. The proofing processes on the illustrative chart below (fig. 1) which have been deemed contract worthy are: dye sublimation for less costly jobs, continuous inkjet for moderate cost print jobs, and dye ablation for high-end commercial printing (3M, A Guide to Color Proofing, 6).

Applying Color Output Technologies to Areas of the Creative and Production Process

Creative or Production Stage	*Print or Proof Repeatability*	*Color Accuracy*	*Popular Choice of Proofing Process*	*Cost-per-proof to Correct Errors*
Sketching and Beginning Layouts	Poor to High	Poor	Liquid Inkjet Phase Change Inkjet Thermal Wax Tranfer	Least Expensive ($.20 to $2.00)
Tight Layouts and Final Designs	Good to High	Poor to Good	Phase Change Inkjet, Thermal Wax Transfer, Dye Sub. and Color Laser	Moderately Expensive ($1.00 to $9.00)
Directly Before Film Output or Platesetting (CTP)	Good to High	Good to High	Dye Sublimation and Continuous Inkjet	Moderate to Expensive ($2.00 to $40.00*)
With Film Output or before Platesetting (CTP)	High to Outstanding	High	Continuous Inkjet and Dye Ablation	Expensive ($30.00† to $50.00*)
After Platemaking from Films	Outstanding	High	Continuous Inkjet and Dye Ablation	Expensive ($30.00* to $50.00*)

** because most design studios do not have proofing equipment costing over $25,000, the cost indicated is that which the prepress provider charges per proof.*

Figure 1 (3M, A Guide to Color Proofing, 4; Hogg, 18-19)

IN HOUSE APPLICATION FOR DESIGN STUDIOS BASED ON COST

After determining which proofer should be used at which point in the design or production process, one needs a general idea of how much different types of printers or proofers cost. As mentioned before, color output devices range in cost from a little under $1000 to up above $245,000. Most printers and proofers which are practical for a design studio to purchase for preproofing do not cost over

$25,000. The following chart (fig. 2) is a simple guide to which output devices and their processes entail which costs. The printers and proofers listed are several popular models at the time of writing.

A Cost Based Guide to the Application of Digital Printers and Proofers

Company	Proofer or Printer Name	Color Output Technology	Resolution in Dots-per-inch	Estimated Price
Hewlett Packard	DeskJet 850c	Liquid Inkjet	600 x 300	$595
Tektronix	Phaser 340	Phase-change Inkjet	600 x 300	$5590
	Phaser 480	Dye Sublimation	300 x 300	$14,995
Fargo	Premera Pro	Thermal Wax/Dye Sub.	600 x 300	$1495
	Pictura 310	Thermal Wax/Dye Sub.	300 x 300	$3995
Lexmark	Optra C	Color Laser	600 x 600	$6849
Apple Computer Inc.	Color Laserwriter	Color Laser	600 x 600	$6989
QMS Inc.	Magicolor CX	Color Laser	600 x 600	$7999
3M	Rainbow 2720	Dye Sublimation	300 x 300	$18,500
Xerox	Majestik	Color Laser Copier*	400 x 400	$67,000
IRIS	Realist 5015	Continuous Inkjet	300 x 300	$44,500
Kodak	XLT 7720	Dye Sublimation	300 x 300	$19,995
LaserMaster	DisplayMaker Pro	Large Format Liquid Inkjet	75 x 150 stochastic†	$29,995

Sources from MacWorld Sept 1995, Publish Dec 1995, Seybold Report on Publishing Systems: Large-format Color Printers 1995, and Windows Sources August 1995.

* *All color laser copiers require a separate controller (RIP). Controller prices are approximately $32,000 to $39,000*

† *The lower resolution of many large format liquid inkjet printers does not decrease their image quality due to their use stochastic screening technology.*

Figure 2

Cost vs. Quality vs. Turnaround Time

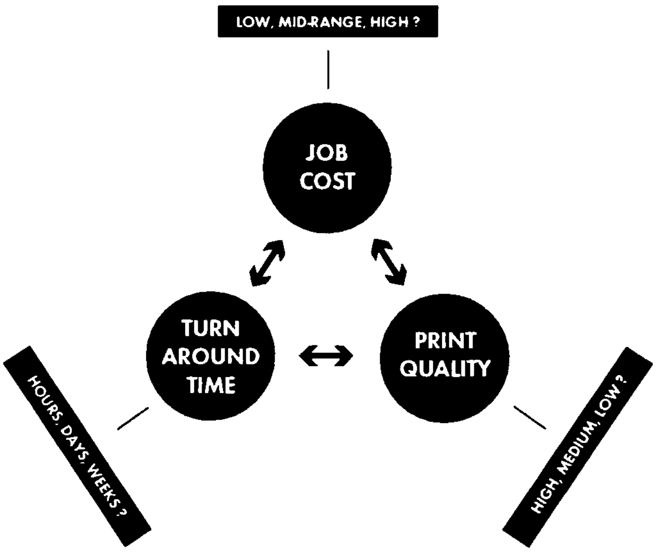


Figure 3

BALANCING COST, QUALITY AND TIMING

The next additional idea regarding the application of digital output devices involves determining the proper balance of job cost, quality, and timing. The diagram (fig. 3) above illustrates a need for balance between these three elements due to current industry trends. The following industry trends are of concern:

1. The production of high-quality, high-cost printing jobs is just beginning to see the acceptance of digital contract proofing.
2. The production of low and middle quality printing jobs have a greater amount of acceptance regarding digital contract proofing.
3. Faster and faster turnaround times are increasingly demanded by the graphic arts industry.

4. Lower cost jobs often require the fasted turnaround times.
5. Remote digital proofing enables faster turnaround times.

Considering the above industry trends, the following two paragraphs discuss ideas related to digital proofing and the balance of job costs, quality and turnaround times.

As mentioned before, the convenience of *remote proofing* is inherent to digital output devices. Many reasons related to the determination of the above balance involve considering the advantageous speed of remote proofing, and its shortening of a job's turnaround time, in regards to the print quality and cost of the job at hand. With the current trend of the graphic arts industry's demand for shorter and shorter turnaround times, remote proofing sites greatly aid those jobs with required turnaround times of only a few days. A digital file may be sent over telephone lines or a fiber optic network to be proofed or printed in a matter of minutes, in contrast to the twelve hour over-night times associated with delivery services.

However, digital *contract* proofing often benefits the most from the speed of remote proofing. Thus the printer must be willing to accept digital contract proofs. Unfortunately, if the quality of the printed job is too high for the printer's trust of digital proofing (meaning a *conventional* contract proof is demanded due to the industry's trust in conventional methods) the added speed of remote proofing and its benefits to job turnaround times will be obsolete. Although this is a disadvantage to the highest quality jobs, middle and low quality jobs will benefit from faster turnaround times. As mentioned above, faster turnarounds are usually associated with lower cost printing jobs, *and* the acceptance of digital proofing in the production process of these jobs is far greater than in the areas of high quality, high cost commercial printing.

Aside from the subject of digital *contract* proofing, color printing and preproofs may also be applied to the *Cost vs. Quality vs. Turnaround Time* diagram in a simplified manner. Within the creative and production processes, color prints and preproofs of differing quality are used. Color prints output during the design process may have low and mid-range color quality, while preproofs made by a prepress provider may display color and image quality just beneath the expectations of those on a contract proof. No matter which area and which image quality a preproof represents, the speed at which they can be made benefits the turnaround time allotted to the job at hand. Additionally, all color printers may be used to perform remote proofing. If copies of a partially designed piece need to be reviewed at different geographic locations for an approval to move on to the next step of the design process, this may be done quickly.

The final consideration related to preproofing and the balance of job cost, quality, and turnaround time is the low expenses related to most color printer devices. With costs-per-proof ranging from $.20 to $9.00, even the most expensive preproofers are economical for proofing within the creative process. The more expensive preproofers, which are owned mostly by prepress providers, may cost significantly more per proof for the client to purchase, but the cost for the provider may average as low as $.69 to $.73 per page (Hogg, 18-19).

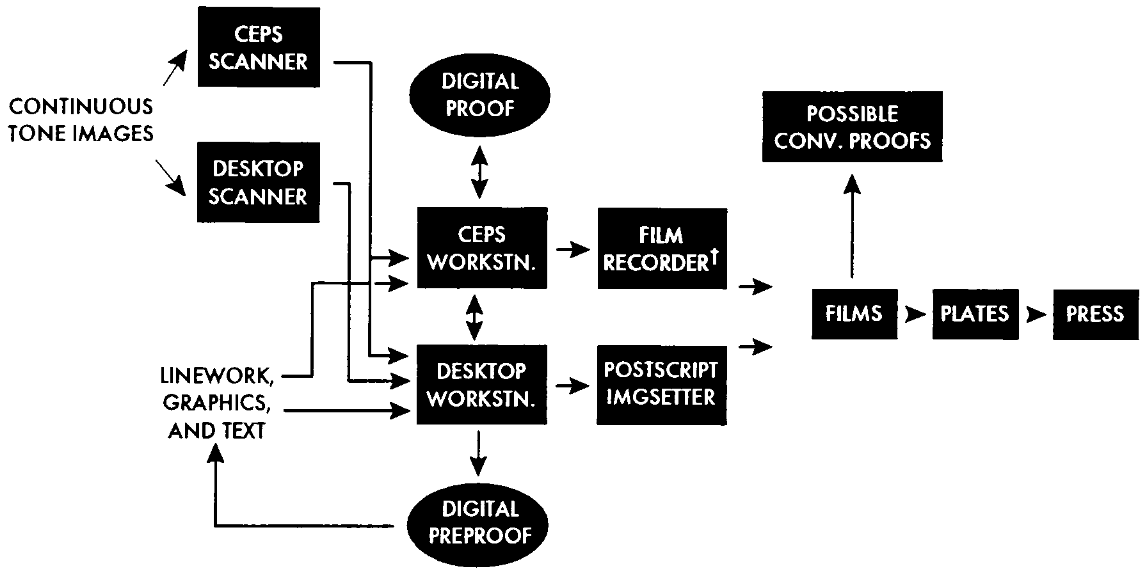
Section 4: *Workflow and Digital Color Output*

In the past, the three basic elements of a printed piece—text, graphics, and imagery—each followed very different creative and production paths to be assembled into a single piece directly before the printing process. Text was hand set to mechanicals, graphics such as logos were made into camera ready art, and imagery was photomechanically separated into three or four process separations. In today's workflow involving desktop publishing and digital prepress, all three of the above elements may be created and/or assembled on a desktop workstation. Type may be input into word processor programs, graphic elements may be created in computer illustration programs, and imagery may be scanned and retrieved by means of flatbed, desktop drum, or high-end drum scanners. This evolution of assembly regarding the creative and production processes of a printed piece has drastically affected the methods used to view tangible evidence of the graphic designs undergoing creation. Digital proofing and color printing are becoming the most frequent methods of tangibly viewing the creative and production stages which a printed piece undergoes. Both fit into a desktop publishing workflow differently. The upcoming two diagrams (figs. 4 and 5) illustrate where color prints and digital proofs may be made during the creation of a digital proof. The first diagram displays a workflow common to the use of an imagesetter with film output, while the second relates to a Computer-To-Plate workflow.

The blocks labeled Color Electronic Prepress Systems (CEPS) are those representing high-end electronic prepress systems which led the way through the original digital prepress process. These systems are closed systems, which means that each one has its own specific hardware and software (3M, A Guide to Color Proofing, 10). CEPS workstations may be connected to desktop workstations, such as the Apple Macintosh, using software interfaces. Their advantages include capabilities to produce very consistent high-end color quality, and in the case of a CEPS scanner, high-end color correct scans. Desktop publishing (DTP) workstations have been integrated into the CEPS workflow, and vice versa, for a number of reasons. For example, the image scanned on a desktop flatbed scanner which serves as a *for placement only* (FPO) image needs to be replaced by a high quality scan for the printing process. This high quality scan is retrieved by a CEPS scanner. Another reason for dual system integration is the added accessibility of a desktop publishing workstation. Although only prepress providers can afford CEPS systems, DTP workstations may be purchased by most any design studio, lending all of their creative tools to the designer.

Amongst the myriad of other reasons for CEPS and DTP workstation integration lies the ability for both to output digital proofs and films. As shown in the following diagrams, proofs and films are output at different times during the creative and production process. These two diagrams are another set of comprehensive ideas aiding the efficient use of digital proofing and color printing (3M, A Guide to Color Proofing, 9-10).

Using Digital Proofing and Preproofing in a Digital Prepress Workflow



In a CEPS system, a film recorder serves the same pupose as the Postscript based imagesetter

Figure 4

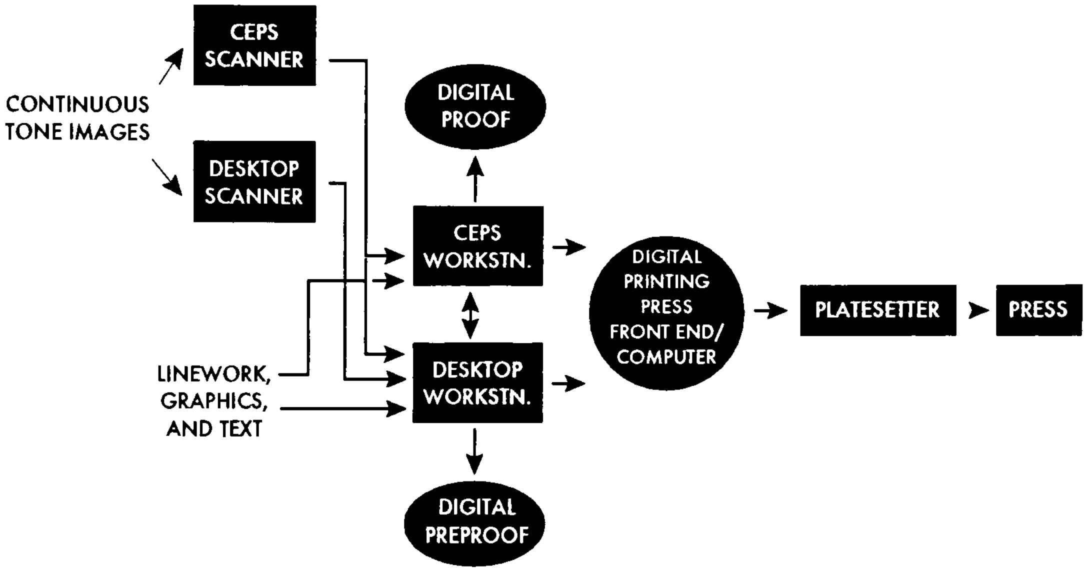


Figure 5

SINGLE SOURCE WORKFLOW: WHEN TO CHECK PROOFS.

Both of the above diagrams display a single source workflow pattern. Within this guidebook, a single source workflow suggests that all design work originates from one design agency. This work then flows into the prepress provider which works under a publisher or client who will distribute the final printed piece. Within this workflow, all stages of the creative process are preproofed and corrected by the design agency and client and/or publisher. The client and publisher decide whether the contract proof is digitally created or not, and whether to compare digital contract proofs to film based proofs. If both are required, possibly due to printing on multiple presses with different attributes, then the prepress provider may need to output films, a digital proof, and create a conventional proof. If the prepress provider needs only to output films and a digital proof, then some publishers require the print house to create conventional proofs with the films produced by the prepress provider. Once created, all digital and conventional proofs are checked by the client and/or publisher (Dennis, 81-82).

DOUBLE SOURCE WORKFLOW:

ADVERTISEMENTS AND EDITORIAL—WHEN TO CHECK PROOFS.

Within this guidebook, a double source workflow, is one which incorporates two sources of creative work for one client or publisher. For example, within the production process for magazine, graphic layouts are created for the editorial content. This design constitutes one source. The second source is the series of advertisements found throughout the magazine. These advertisements have been created and proofed by different designers and prepress providers than that which the publisher uses for in-house editorial work. All editorial work is proofed and preproofed under supervision and with the standards set by the publisher. The digital files, films, and digital contract proofs created by the advertisers may or may not be re-proofed by the publisher's print house. Whether re-proofs are or are not created depends upon how long a publisher and advertiser have been working together. In this case as well as within a single source workflow, all contract proofs of both advertisements (proofs or re-proofs) and editorial designs are approved by the client and/or publisher (Dennis, 82).

WHERE HAS DIGITAL CONTRACT PROOFING BEEN ACCEPTED?

After considering the advantages and disadvantages of color printing and digital proofing, the output technologies applied to specific points in the production process, and when they should be checked, one needs to realize when digital contract proofing is currently accepted by the graphic arts industry. The first area in the industry to accept digital contract proofing was that which uses the gravure printing process. In the gravure process, there are no films required to create printing plates. Imagery is etched onto large copper cylinders by the digital front end of the printing process. With no films to create conventional proofs, the coming of the first digital presses in the industry demanded digital contract proofing.

Other areas of the graphic arts industry which accept digital contract proofing use the offset lithographic printing process. Offset litho, the most commonly known printing process, uses printing plates on a press to transfer imagery onto the printing substrate. Currently, there are two general types of digital prepress processes involved with the offset lithographic process. As mentioned before, one uses imagesetters and film output, while the other is a Computer-To-Plate system. Both of these workflows may further be divided into three levels of printing quality. The highest quality level, which requires the most accurate reproduction of color and image fidelity, involves particulars such as the reproduction of fine art and several applications of high-end commercial printing. On this level, digital contract proofing is just beginning to be accepted. Only halftone-based digital proofers are found to be accurate enough for use upon this level.

Mid-range printing, requiring slightly less quality in regards to color accuracy and image fidelity, involves the printing of periodicals, books, and a myriad of different commercial printing applications. The middle level also encompasses a modest use of CTP systems. On this level, digital contract proofing may be accepted 30% to 40% of the time. Both halftone based digital proofing, continuous inkjet proofing constitute these percentages.

On the bottom level of printing, which requires the lowest amount of color accuracy, involves items such as newspaper advertisements, bulk mailers, and magazine inserts. Upon this level, digital contract proofing has been accepted about 60% to 70% of the time. The proofing devices and their processes found on this level include dye sublimation printers, continuous inkjets, and if the budget permits, halftone based proofers (Redding, 1996).

Section 3: *Marks and Their Definitions*

Correction Groups

How many different areas of a color print or digital proof are there to observe during the correcting process? How should one approach these areas to thoroughly check the output at hand? To answer these questions, one first needs to realize all of the different details which may need tuning on a preproof or contract proof. These details may then be divided into groups for easier recollection. This section provides groupings of preproof and contract proof correction areas for the designer to check when viewing digital output. Some corrections take advantage of a small set of standardized graphic symbols to efficiently communicate a selected problem to a prepress technician. These symbols and their explanations may also be found here.

Please note that although many of the following correction areas pertain to both preproofs and contract proofs, some *do not.* To denote which corrections apply solely to preproofs or contract proofs, they have been marked accordingly with: **CP** (only applicable to contract proofs), or **PP** (only applicable to preproofs)—otherwise, all listed corrections and ideas are pertinent to both.

Group 1: *Digital File Tracking and Identification*

ARRIVAL AND REPLACEMENT DATES OF IMAGES (of specific files in job)

If new or replacement files have been added to the latest proof, or if these files need to be updated with new images or graphics, a label displaying the dates and names of the specified files should be created. This will allow prepress technicians to verify that they have the most recent versions of all of the files needed to create the latest version of a preproof or contract proof.

MEDIA FORMATS

The media on which image or graphics files are stored on needs to be noted when transferring proofs and data between the design firm and prepress provider. This enables each party to verify which equipment is needed to view or modify the pending artwork. Labels including, but not limited to, these widely used types of storage media may be addressed: SyQuest, Optical, Floptical, Floppy disks, Bernoulli, Iomega Zip and others.

LISTING FILE NAMES AND LOCATIONS

Graphics file names and their locations on storage media should be noted on a proof if new files have recently been added to the layout of the design. This enables all viewers to easily identify and locate any last minute additions or graphics that have changed since the last generation of proof that was observed. When marking a file for name and location, the following details should be prominent in the label: the exact file name, file directories for PC format media, and folder names and locations for Macintosh format media.

PRE-CREATED DIGITAL FILES

Within this guidebook, a pre-created digital file is one that is handed down to the designer by the client containing a standardized graphic which needs to be included in the design at hand. Most often, pre-created files are corporate logos, trademarks, or any other graphic that has been standardized by a client's existing corporate style manual. These files need to be identified because they often contain colors or graphics that require an extra *hit* on press (printing an extra color in addition to the four process colors). Often, a registered corporate Pantone color, such as Kodak Yellow, appears in a pre-created file. In such a case, labeling and investigating the pre-created file aids in the decision as to whether or not additional colors must be added to the printing process.

LISTING ORIGINAL AND CURRENT IMAGERY FILE FORMATS

When a layout contains many imported files, it is best to label file formats if by chance one imported file has been created in a different format than the others. Also, if file formats have been converted at any point in the production process, problems which may arise in the new file format are often traced back to original file formats. This is especially true when vector based graphic illustrations have been imported into pixel based programs such as Adobe Photoshop. Labeling such conversions will speed up any investigation of problematic graphic illustrations or imagery due to file formats.

NOTEWORTHY CONSIDERATIONS FOR RESTRICTED FOUR COLOR PROCESS PRINTING

There are certain restrictions which apply to all printing which is limited to the four process colors. It is important to consider these restrictions when viewing a proof which has been made for a four color job. These restrictions are as follows: (Kochesberger, 1995)

1. Spot colors will be reproduced by cyan, magenta, yellow and black. This is actually advantageous due to the fact that one does not have to interpret how the true spot color will appear. Of course this is only true when the digital proofing system is calibrated with the press on which the job will run.

2. Computer illustrations including custom or spot colors such as those created with Adobe Illustrator and/or Macromedia Freehand will all be displayed using cyan, magenta, yellow and black. Unless printing directly from an illustration program this conversion of custom colors automatically occurs when the illustration is imported or placed in a pixel based program such as Adobe Photoshop.

3. Many jobs which are restricted to the four process colors are printed on lower quality stocks such as periodicals. These lower quality uncoated or lightly coated stocks absorb inks to a greater extent, therefore mottling colors and creating other degradations in image fidelity. It is important to consider these disadvantages, even when the proofing system is calibrated to a specific press or printing process.

Group 2: *Evaluation of Design Elements*

TRADE AND PRODUCT SYMBOLS

When evaluating prints and proofs, verification of elements such as trade symbols and other product symbols must occur. If these symbols appear undesirably in photos or in other locations of a design they must be changed or removed by what may be time consuming and/or expensive image editing. Therefore it is best to correct trade and product symbol appearances as early as possible in the design process.

DETERMINING REQUIRED DESIGN ELEMENT COLOR ACCURACY

Every design element and image has a certain amount of importance in regards to its composition, size, color and overall appearance. When reviewing a color print or digital proof, it is important to decide an element's required color accuracy. Certain images may require a low amount of color accuracy, while others such as simulated spot colors require a very high amount of accuracy. During the design process and especially before the final contract proof, one must determine compromises, if any, in design element and image color accuracy. Any details regarding color compromises due to printing processes or project expenses should be noted—most effectively during the design process with the use of pre-proofs.

TYPE AND ELEMENT KNOCK-OUTS

While inspecting design compositions with text and display type knock-outs or ones containing entire graphic element knock-outs, it is important to label any potential problems regarding these areas. Watch for small serif text which tends to loose definition when knocked out of process color imagery or simulated spot colors. Also graphic elements such as small logotypes and corporate signatures with high amounts of detail may tend to loose definition when knocked out of several process colors.

PANTONE MATCHING SYSTEM AND SPOT COLOR CALLOUTS CP

No matter which system of spot colors is used with a design, it is important to attach a color swatch for any ambiguously represented spot colors to a proof or preproof. As every proofing system's technical processes and output is different, simulated spot colors displayed on a proof or preproof may vary greatly. Not even the highest quality digital proofer can display certain spot colors correctly. In fact, the only *conventional* system most creative professionals trust for viewing accurately displayed spot colors is DuPont's Cromalin (see appendix B – field research) — the Cromalin proofing system enables the technician to custom mix spot colors in much the same way as a printer would custom mix a Pantone ink. The reason that spot colors are so hard to simulate is that no matter how the four process colors are combined, certain spot colors still exceed all process color gamuts. They may be too saturated, too bright, or a combination of both. In order for other viewers, especially a pressman, to correctly perceive a spot color, they must have a sample of the actual spot color at hand — a spot color callout.

A good way to avoid the misperception of simulated spot colors is to realize which true spot colors are the most different from their simulated counterparts. Pantone provides a guide which directly compares each Pantone color to a process color simulation of the same PMS swatch. With this guide, it is very easy to realize which simulated spot colors vary the greatest from their true PMS counterparts. It is good practice to keep these highly differentiated pairs in mind while viewing graphic layouts containing multiple spot colors.

EXAMINATION OF PHOTOGRAPHIC IMAGE ELEMENTS CP

As mentioned above in the section entitled *Determining Required Design Element Color Accuracy*, deciding how accurate a design element's color needs to be is a crucial step in the production process. After a decision has been reached, another step must be taken with the reproduction of photographs. When inspecting photographs, there may be several areas in a single photo which need tuning. After a thorough inspection, it is best to describe or list all of the problematic aspects of a photo when correcting the proof. This will help a prepress technician uncover a technical aspect which could correct all of the problems at hand. For instance, if comments on a photograph tell of an overly saturated blue sky and green tree leaves which seem too deeply colored or oversaturated, the prepress technician should know to possibly reduce the amount of cyan which is printing in the photograph. Too much cyan can cause overly saturated blue skies (extra cyan supersaturates the blue in a blue sky) and make green tree leaves a vibrant, deep blue green (extra cyan combined with the green of tree leaves super-saturates them and turns them into a vibrant blue-green). Several comments written and explained like those mentioned above could very well speed a first generation digital proof on to a final contract proof.

Group 3: *Evaluating Colors*

VERIFICATION OF CORPORATE COLORS

Corporate colors are often printed in a job with an extra color on press. It is important to label whether or not corporate colors in a graphic layout need to be printed with a custom Pantone color which is owned by a large company such as Fuji's corporate green, or Kodak's yellow. If they are not to be printed with a custom spot color, then the prepress provider must know to place extra emphasis on matching the desired color with its simulated process equivalent. Labeling which action needs to occur early on in the design process enables all viewers of proofs or preproofs to determine the accuracy of all corporate colors used in a design.

MATCHING PREVIOUSLY PRINTED SAMPLES

During the design process several proofs and preproofs may be produced. At some point an art director may prefer the colors of photographs or design elements in a preproof or digital proof which was produced during the design process. When this occurs these colors must then be matched by the prepress provider. To do this, a prepress technician may have to spend costly time manipulating imagery and other graphic element colors to match those of a preproof. It is important to clarify which previously printed sample colors need to appear in which way. As early as possible in the design process, these colors and elements must be clearly labeled. The sample, preproof or proof, should be present when any subsequent output is viewed—*subsequent output* meaning output which is made after the proof on which one altered the desired color values during the design process (Kochesberger, 1995).

SCREENING OF TRUE AND SIMULATED SPOT COLORS

There are several differences between screening a *true spot color* and a simulated spot color. When screening a true spot color, there are few cautions to be taken. This is due to the fact that only the halftone screen of one printing ink is being changed to lighten the hue of that specific spot color. However, when simulated spot colors are screened, as with all digital proofing mechanisms or on a four color (C M Y K) press run, all four process colors and their halftone screens or shades must be lightened. When this occurs on a proof or press, a screened, simulated spot color can be drastically affected. It may display *hue shifts, banding,* or differences in saturation and lightness. It is important for the creative professional to realize that this may occur on all digital proofs and may or may not appear on press. If any of the above effects are observed, one should make a note on the proof questioning whether the same effects may occur on press. The prepress provider and/or printer should be able to answer any questions regarding how the specific printing process will affect screened, simulated spot colors.

CHECKING BLENDS

As mentioned above, screens of simulated spot colors are often affected on digital proofs and preproofs. Blends of simulated spot colors may also be affected adversely. They may display banding and high amounts of color inaccuracy. When checking the quality of blends in vector based computer illustrations or other design elements, it is important to label any appearances of the above effects.

VIGNETTES

As vignettes are fades of spot colors, they may also display banding or color inaccuracies. As with other simulated spot colors on digital proofs or preproofs, a note should be made to question whether or not inaccuracies on the proof will occur on press. It is also important to denote the names of the true spot colors which create vignettes through the design. This notifies all viewers as to whether or not an extra color may be printed during the press run. If vignettes are not to be comprised of an extra color on press, then they should be marked as four color simulations.

Group 4: *Labeling and Clear Handwriting*

The corrective areas of this group, related to design and layout adjustments, are those that use a set of standardized graphic symbols provided with the guidebook. These graphic symbols have been designed so they are most easily reproduced by hand with a marking pen or wax pencil. The ideas below related to element positions, dimensions, and color properties are those which may be addressed with general knowledge of design and proofing. Any further detail or mark-up based on the following areas may be considered confusing to a prepress provider. This includes labeling photographs and objects with specific increases or decreases in any of the four process colors. As explained in the latter section *Color Balance Issues for Prepress*, certain details are best left to the prepress technician with a complete knowledge of color and its adjustment.

POINTERS AND CLEAR HANDWRITING

Perhaps some of the most basic attributes to labeling proofs are clear handwriting, clearly pointing to graphic elements, and color areas. Make sure to consider the following:

- use capital letters if lowercase letters have caused confusion in the past
- signify small areas by circling them, and large areas by circling them or using pointers.
- when circling or signifying color adjustments, make sure to state the color's increase or decrease by using the graphic symbols found later in this section.

Group 5: *Element Positioning*

The following graphic symbols may be used to communicate positional change of graphic elements, display type, and text type. They have been created to work alongside of textual comments. Any comments which require measurements should retain a consistent set of units (metric or standard). Some comments have been suggested for several of the symbols below.

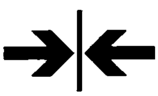
OBJECT MOVEMENTS

These arrow symbols are to indicate the movement of graphic objects and text. They should be used with a written amount of movement in consistent units.

← → ↑ ↓

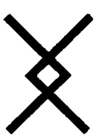
ADJACENT ELEMENTS

This symbol should be used if two elements are supposed to be exactly adjacent to each other, but do not appear so on the proof at hand.



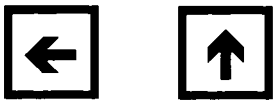
INDICATING ELEMENT OVERLAPS

The overlap symbol should be used when elements need to overlap more so than they currently seem to on the proof at hand. If necessary, a written measurement of the desired overlapping distance should be noted.



FLIP ORIENTATION OF AN OBJECT

If an object has been accidentally flipped by means of digital manipulation or placement in the page layout program, the flip orientation symbol can be used. It has two options: flip top to bottom and flip left to right.

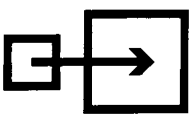


Group 6: *Element Dimension Adjustments*

The following symbols are to show a change in an element's size, or to question the current size of any graphic appearing on a proof. As with the previous section, consistent units should be used. In addition to dimension measurements, typographical measurements may also be used: picas and point sizes.

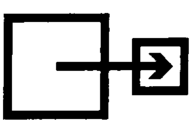
ENLARGEMENT BY PERCENTAGE

The enlargement symbol is to be written with a specific percentage or final element dimension next to it.



REDUCTION BY PERCENTAGE

The reduction symbol is to be written with a specific percentage or final element dimension next to it.



CHECKING ELEMENT DIMENSIONS

This symbol is to be used if the dimensions of a graphic element or photograph need to be verified or changed. If desired, the dimension of the element which is being questioned may also be placed next to the symbol. As with all other symbols, use consistent units.

Group 7: *General Color Statements*

The following symbols have been created to show needed color modifications on photographs or graphic elements. They have been limited in scope so as to lessen potential confusion during review of the corrections by a prepress provider. More specific corrections and ideas are introduced in the section entitled *Color Balance Issues for Prepress*. However these ideas will be left to a prepress technician with a complete knowledge of color and its adjustment.

COLOR SATURATION ADJUSTMENTS

The intensity of a color, or its saturation, may need adjustment in a graphic element or a specific photographic subject. The following two symbols are used to indicate the brightening or darkening of a specific color's saturation. The filled circle means to darken saturation, while the hollow one means to brighten saturation. Next to each symbol should be written the color of the object to be brightened or darkened. It may also be helpful to circle the photographic subject matter or element which needs tuning.

● ○

ADDITION AND SUBTRACTION OF SPOT COLOR INTENSITY

Due to the fact that all digital proofing mechanisms display simulated spot colors, it may be necessary to indicate their adjustment. Simulated spot colors are often lighter or darker than their true spot equivalents. By looking at the proof and a Pantone Color Formula Guide under controlled lighting conditions, one may decide whether a simulated spot color on the proof appears to be of lesser or greater intensity than it should be. The >*PMS* symbol is used to indicate that additional spot color intensity is required, while the <*PMS* symbol is used to indicate that the subtraction of spot color intensity is required. Note that the initials of the utilized color matching system should replace PMS.

< PMS 106 **> PMS 106**

ADDITION AND SUBTRACTION OF RED, GREEN, AND BLUE COLOR INTENSITY

When observing photographic imagery on a digital proof under controlled lighting conditions, it is safe for the designer with general color knowledge to comment on the intensities of reds, greens, and blues. The adjustment of the process colors requires more experience and a greater knowledge of color and the printing process. To limit confusion with a prepress provider, only reds, greens, and blues should be commented upon by the graphic artist. For more information on this subject of process color adjustment, a section entitled *Color Balance Issues for Prepress* appears at the end of this section. The following symbols may be used to indicate RGB color adjustments. The >*R, G, or B* symbol is used to indicate that additional color intensity is required, while the <*R, G, or B* symbol is used to indicate that the subtraction of color intensity is required.

<R, G, B   >R, G, B

LIGHTENING AND DARKENING OVERALL IMAGE APPEARANCE

The following symbols are to communicate a desired lightening or darkening of an entire photographic image or illustration. The filled square indicates the viewer would like the image to be darkened, while the hollow square indicates the viewer would like the image to be lightened overall. A written percentage describing how much adjustment is required should appear next to the filled or hollow squares.

■   □

LIGHTENING AND DARKENING HIGHLIGHTS, MIDTONES, AND SHADOWS

Highlights, midtones, and shadows in photographic images may each need to be tuned. To indicate a desired lightening or darkening of these image qualities, the letters H (highlight), M (midtone), and S (shadow) are added to the Lighten and

Darken squares. In addition to the squares and H, M, or S, a written percentage should appear describing how much adjustment is required.

□ **H, M, S** ■ **H, M, S**

Group 8: *Production Notes*

The following production notes should become usual labels and correction marks. They are some of the simplest of all the corrective areas to cover. However they also cover some of the most basically important production details. Items such as bleed specifications, page dimensions, and the number of colors to print on a job can never be too obvious to any viewer. If they are mistaken, some of the most expensive revisions may need to be made. By marking the information of the following areas on every preproof or proof that needs them, prepress providers and designers can avoid these costly pitfalls.

LABELING DESIGN DIMENSION CHANGES

During the design process, the final dimensions of the project at hand may or may not change. If these dimensions change at any point during the design process, they should be noted on any preproofs or proofs. The label should compare the previous layout dimensions to the new ones, including names of any digital files which were altered, and the date that any changes occurred. This enables all viewers to realize which changes occurred when and if they need to complete any changes started as of the date listed.

LABELING OF ENDING PRESS SHEET DIMENSIONS

As stated above, the final dimensions of a design may change during the creative process. However, once the final dimensions have been established, it is practical to label them, especially if a job has changed size often. This should most importantly be done on the final preproof.

VERIFICATION OF BLEEDS

Bleeds on photos and graphic elements should always be confirmed. A label confirming a bleed should state how much a design element bleeds over the edge of a page and the date of any newly added elements which require bleeds. This confirmation should also occur on the final preproof.

STATING NUMBER OF COLORS TO PRINT

Another important production note for multiple color jobs is the number of colors to print. If certain pages of a job require more colors than others, it should be stated. This informs viewers of simulated or true duotone and tritone images, as well as spot colors.

LABELING PROOF PAGE NUMBERS

For jobs with multiple pages or facets (on a folded brochure), page numbers need to appear on preproofs and proofs. Page numbers denote how far along the viewer is in the design composition if there is no numbering system in the design itself.

When designing and producing computer illustrations or any vector based art, electronic trapping must occur. Programs such as Luminous Trapwise are used to produce traps on films or with platesetters. In regards to digital proofs and preproofs, registration is almost never a problem, so traps are not apparent. This however does not mean that the creative professional should expect trapping to always occur perfectly—especially if one is working with a new prepress provider. If the designer knows which colors need to be trapped, then reminders on final preproofs and contract proofs should be written. These labels should simply include the names of the colors to be checked for spreads and chokes—the colors to be trapped.

Unfortunately, trapping in the graphic arts industry does not always have one meaning. To the printer, trapping may mean the wet and dry trapping of ink on press, or the spread and choke of two colors around a common boundary to prevent unwanted paper color from showing through on a final press sheet (Romano, 242). For the application of proofing, the latter is the one to be concerned with.

Group 9: *Color Balance Issues for Prepress*

As mentioned earlier, general knowledge about color is sufficient to allow one to comment on and correct photographs and graphic elements to a certain extent.

This extent includes judging the proper hue, saturation, and lightness of spot colors, or deciding whether red, green, and blue must be added to a photograph. Determining proper highlights, midtones, and shadows may also be simply accomplished. However, the knowledge of most viewers stops here. Any further judgements about addition and subtraction of the process colors may become confusing for a prepress provider. In many cases and due to corporate policy, the misjudgement of process color adjustments by a viewer may require a prepress provider to carry out the instructions when he or she knows they are incorrect. Then, after a new proof has been created and the adjustments verified as being incorrect, another proof must be made with the proper adjustments. This takes time and money which may often be easily saved by simply not carrying out process color judgements with incomplete color knowledge. It takes experience and skill regarding additive and subtractive color theory, as well as with the proofing process being utilized to efficiently judge the need for process color adjustment. For more information on additive and subtractive color theory, see the Color Primer.

Section 5: *Correcting Color Prints as Opposed to Correcting Digital Proofs*

Most all of the above correctional ideas may be applied to both preproofs and proofs. The exceptions being those marked for contract proof application only (**CP**). However, correcting preproofs involves allowances for color variations and text variations which most often do not occur on digital contract proofs. Color variations include inaccurate spot colors and hue shifts or overall color shifts in halftone imagery or other graphic elements. Specific image fidelity inaccuracies according to different proofing processes may be found in Chapter Four. Text variations include jagged edges on small type or display type, blurred typographic element edges, and character weight changes. Specific proofing process effects on typographic elements may be viewed in Chapter Two. The most valid checks on preproofs involve design composition judgements, general color evaluations (pleasing color), text flow, and overall graphic element appearances.

When checking and correcting digital contract proofs, all of the allowances taken into consideration for preproofs should be painstakingly evaluated. Color accuracy of all graphic elements and photographic imagery should be observed for hue shifts and color casts. Text should be checked in regards to proper character weight and edge smoothness characteristics. Essentially, every detail regarding colors, text, and the qualities of the graphic layout should be evaluated.

Chapter Two

Proofing Typography

Chapter 2: Proofing Typography

Section 1: *How the Different Printing and Proofing Processes Affect Type*

Typographic design elements are displayed and created with a multitude of qualities and output processes depending on the digital proofer or printer being utilized. As most currently marketed color printers and proofers do not have the ability to produce extremely high resolution output (above 600dpi), two of the most affected areas of a design are the crisp outlines of display type and text type. The actual resolution of many color printers does not exceed 300 dots per inch (dpi). Therefore the text type produced by them appears similar to that of the average black and white laser printer. In fact, many 300dpi black and white laser printers output typography better than color printers working at the same resolution. This is due to the fact that the toner used in b/w laser printers often consists of much finer particles than those found in the materials used with the output processes common to color printers. For example, thermal wax printers melt and transfer small spots of pigment colored wax onto a substrate. Although these spots are created by thousands of miniature heating elements within the device's thermal printhead, they are still larger in size than toner particles. For more information on printing and proofing processes, see the *Proofing and Printing Process Supplement* at the beginning of Chapter Five.

In addition to the above consideration of different types of proofing process materials, it is easy to jump to the conclusion that the text quality of a proofer or printer will mimic its image quality. However, this is certainly not the case with many continuous tone output devices which produce high quality, near photographic imagery. Even the continuous tone imagery of the 3M Rainbow dye sublimation proofer and the IRIS 3047 continuous inkjet are not printed at resolutions above 300dpi. Although this resolution may produce outstanding continuous tone imagery, a 300 dot-per-inch typographic element, be it text or display type, will suffer from such a low printing resolution.

In order to clarify the effects of different printing and proofing processes on typographic elements, the following sections illustrate how text and display type appear when output by all presently popular color output technologies. With each section, a sample of text type and display type are shown. Note that all text type, with the exception of the LaserMaster Displaymaker Professional's text type, ranges from 10 to 14 points in size. That which is found on the the Displaymaker is approximately 24 point "text" due to the extreme measurements of the proof. Several samples of unusually small text are also displayed. These samples range between the type sizes of 3 points and 9 points. Additionally, all of the following samples of display type range from 24 to 72 points in size.

Text Samples of Color Printers and Preproofers

Liquid Inkjet

Liquid inkjet printers are amongst the lowest cost group of all color output devices. Their resolution ranges from below 300dpi to approximately 720dpi. The following two text samples were printed on a Tektronix Phaser 140 at 360dpi. While the larger overview (fig. 7) of the text type seems reasonably sharp, the close-up (fig. 6) of the same letters are very rough. Character weight is heavy due to this rough definition. All character edges are also coarsely defined with little smooth rendition. A few random dots of ink are also evident surrounding each letter. These dots are the result of loosely controlled, excess ink being sprayed through the printhead.

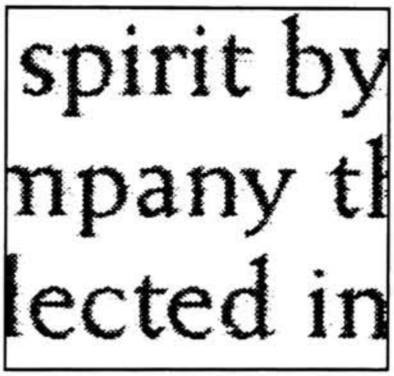


Figure 6

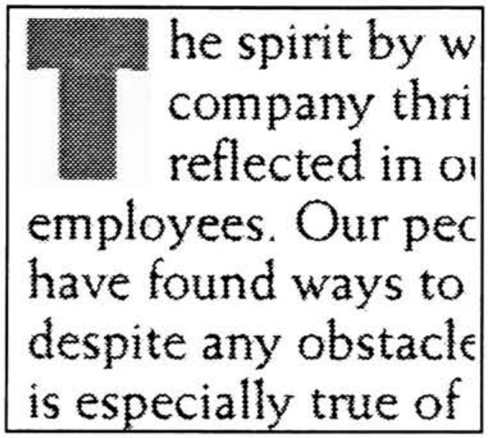


Figure 7

In addition to the text type shown above, the following sample (fig. 8) displays 8 point sans serif text. Here the limitations of liquid inkjet text quality are especially obvious. All curves and diagonal strokes are plagued with sharp, jagged bitmap-like lines.

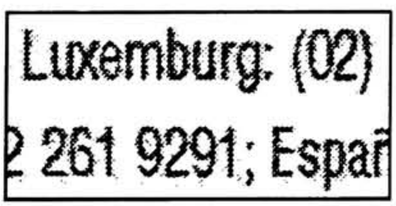


Figure 8

The samples of display type (figs. 9 and 10) found below, have been printed on the same printer. The large letter "O" and the colored letters "A" and "V" still show jagged edges. Even at the larger size of this display type, the liquid inkjet printer at above the average 300 dots-per-inch shows poor typographic quality. Although this quality increases with greater resolution, liquid inkjet technology still displays poor to average typographic elements.

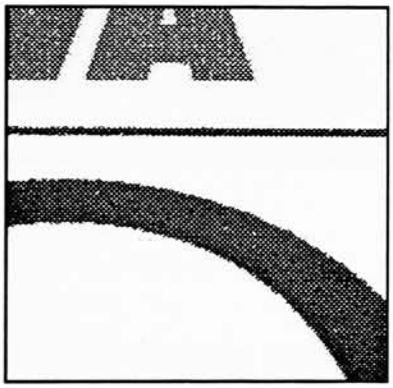


Figure 9

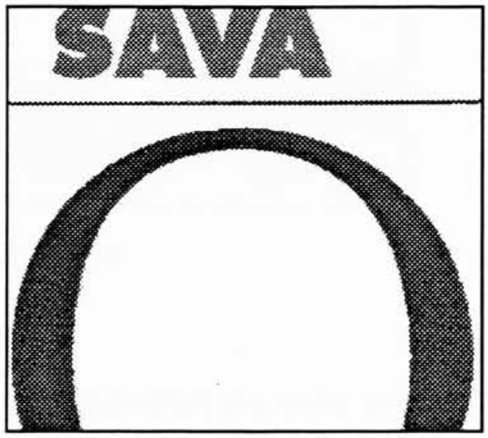


Figure 10

LARGE FORMAT LIQUID INKJET

Large format liquid inkjet printers display several imagery and text characteristics which are unique to their format of printing. The sample (fig. 11) of text type below (mainly the "TM" trademark text) show very rough and unrefined edges. These edges are the result of the lower resolution common to these printers. The samples below were both printed on a LaserMaster Displaymaker Professional. The sample output, which was printed at 75 dpi, measured 3 foot, 6 inches wide and 4 foot, 6 inches high. As with most large format prints, it was created for the purpose of being viewed from at least 2-3 feet away as a poster. Considering this, the text and its coloring are of adequate quality. However, when viewed up close, the print's low resolution becomes apparent.

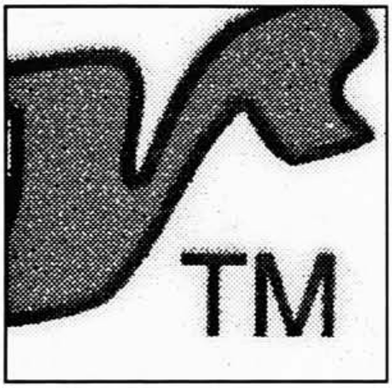


Figure 11

Figure 12

The two samples below show display type from the same print. As these letters are reversed out of black, their edges seem a bit smoother than those of the text type. However, the low resolution of the entire print is still apparent in the color of the lettering. With the naked eye, cyan, magenta, and yellow spots within the close-up view of the text may be seen (fig. 13). As one backs away, these spots blend to make an orangish-tan display type colorant (fig. 14).

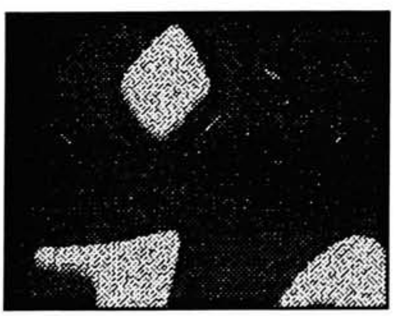


Figure 13

Figure 14

The following two samples were printed on a Tektronix Phaser 240 thermal wax printer at 300 dpi. Although the edges of the text type still bear the roughness of a 300 dpi printer, the blacks are very solid in the close-up view (fig. 15). Serifs on all text are well defined.

Figure 15

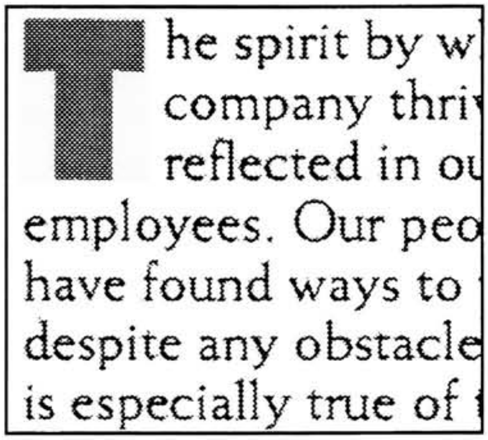


Figure 16

However, the smoothness and definition of 12 point text type is lost on the smaller 8 point type below (fig. 17). Jagged edges are especially apparent on diagonal letter strokes and curves. Some letters have even lost uniformity in the weight of their strokes.

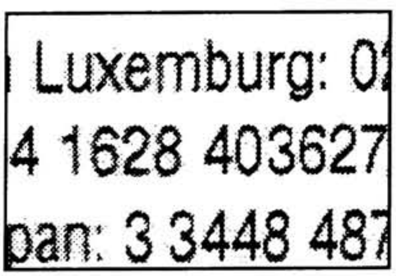


Figure 17

On the display type samples below (figs. 18 and 19), some jagged edges may still be seen on larger size letters. However, when compared to the lettering found on most liquid inkjet output, all characters are much cleaner in appearance. Any excess spray of ink is not apparent due to the cleaner operation of the thermal wax transfer process.

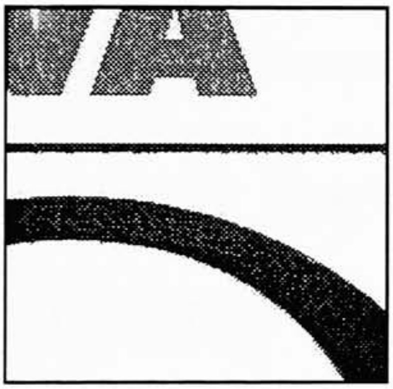


Figure 18

Figure 19

PHASE-CHANGE INKJET AT 300DPI

The following samples of text were printed on a Tektronix Phaser 300i phase-change inkjet printer at 300 dpi. Within this and other phase-change inkjet printers, the ink which is sprayed onto the substrate originally comes in the form of a solid ink cartridge. Bits of this cartridge are melted into ink droplets which are sprayed onto the substrate. After being sprayed, the ink droplets solidify on the substrate as they cool. The first phase change (solid ink to liquid droplets) and the second one (liquid ink droplets to solid ink spots on the substrate) both help to rid the output from a phase-change color printer of many excess ink spots around text type and other small elements. An example of these spots may be observed earlier in this chapter through the section entitled, "Liquid Inkjet". Although the phase change process promotes overall cleaner printed output, some of the same spots around the text type in the following examples may be seen. Also notice that small serifs (fig. 20) are not nearly as crisp in appearance as they may be seen on the previous section's thermal wax printer output. Additionally, all text type characters, especially those with diagonal strokes, display noticeably jagged edges.

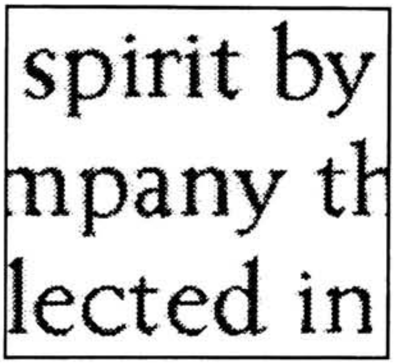


Figure 20

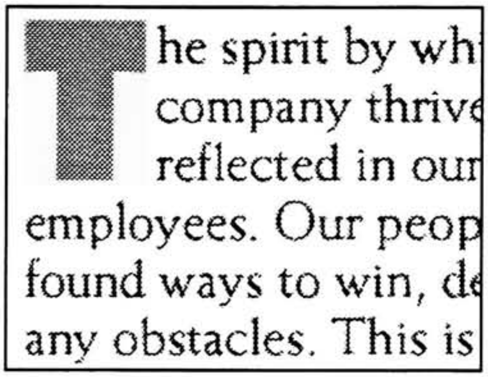


Figure 21

A clearer example of jagged edges may be observed on the 8 point type in the following sample (fig. 22). As with both the thermal wax and liquid inkjet printer output, characters in these smaller samples loose uniformity of letter strokes and limbs. The vertically oriented portions of many letters appear thinner than their horizontal counterparts.

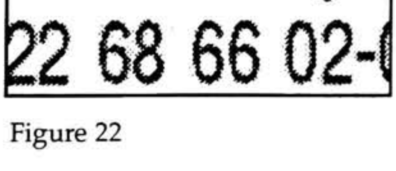


Figure 22

Although the text and smaller type samples shown above may show jagged letter strokes and a few extra droplets of ink, the display type below (figs. 23 and 24) is well rendered for a 300 dpi printer. All edges are well defined with apparent but not obtrusively coarse letter strokes and limbs. The most jagged edges are found in the slight curves of the letter "O' and the diagonals of the letters "V" and "A".

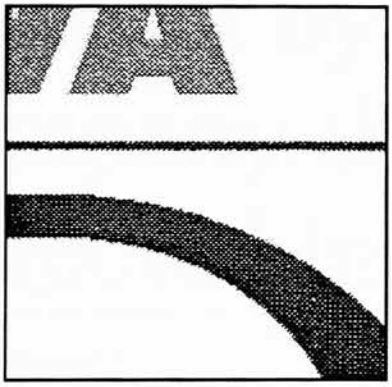


Figure 23

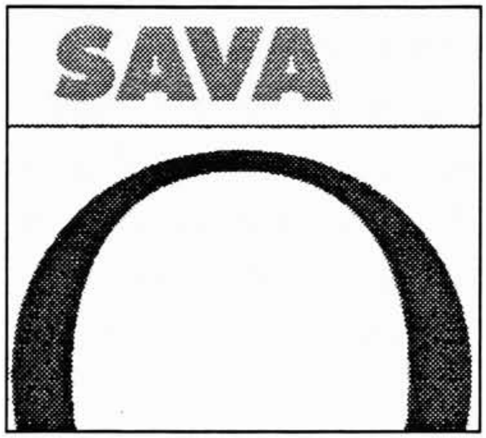


Figure 24

PHASE-CHANGE INKJET AT 600 X 300DPI

Many color printers possess a greater print resolution when the printhead moves from the top to the bottom of a page in comparison to when it moves from one side of the page to the other (600 dpi from top to bottom and 300 dpi from side to side). This means that the printhead moves down the printed page at increments which measure approximately half the size of those used to move across the page. The following samples (figs. 25 through 27), which were printed on a Tektronix Phaser 340 phase-change inkjet printer, show text at a resolution of 600 x 300 dpi.

Although such a resolution benefits photographic imagery more than text or graphics, some added textual sharpness may be noticed below. The smallest text (fig. 27) also looses its tendency to have non-uniform letter strokes and stems. Unfortunately with the added sharpness and twice as many passes by the print-head, these text characters have gained weight as well.

Figure 25

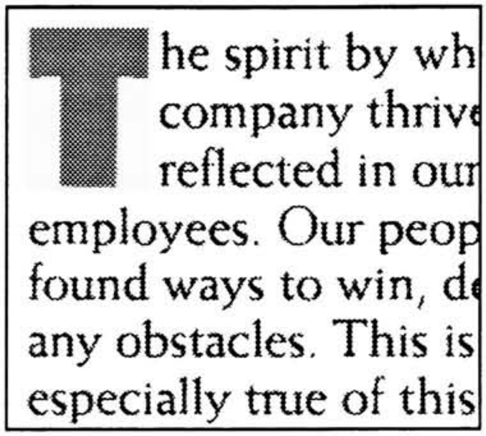


Figure 26

Figure 27

Dye Sublimation

Dye sublimation proofers use a process which produces exceptional continuous tone imagery at low resolutions such as 300 dpi, while having the tendency to compromise text and small type qualities. In the past, dye sublimation printers had the tendency to blur text and any sharply edged graphic. Currently, many of them have sharpened their edges. However, the results have been similar to the jagged edged type of other 300 dpi printers. Additionally, very small type, about 3 to 6 points in size, still displays some undefined or blurry borders.

The first two samples below display how dye sublimation proofers currently render text type with jagged edges. From afar (fig. 29), most letters, especially the small capitals, seem very well rendered. Up close (fig. 28), these letters no longer mimick the quality found in the continuous tone imagery of dye subs. They show coarse curves and jagged diagonals.

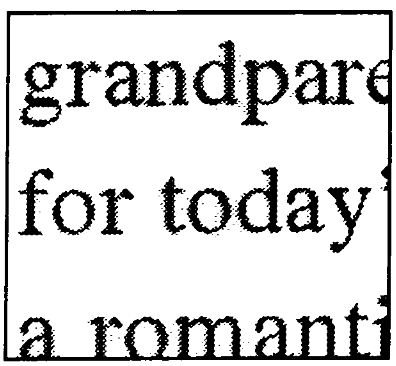


Figure 28

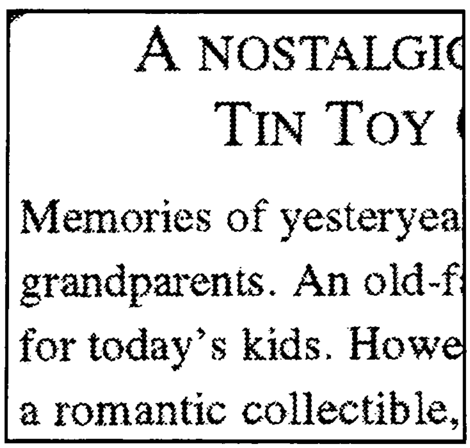


Figure 29

The next two samples illustrate how dye sublimation printers have the ability to print higher quality display type. In the larger view (fig. 31) the display type shows high definition and distinction from the photographic background. Up close (fig. 30), only finely rendered jagged edges are apparent. Note that no blurring of any textual elements is evident, and all corners of the sans serif letter structure are very sharp.

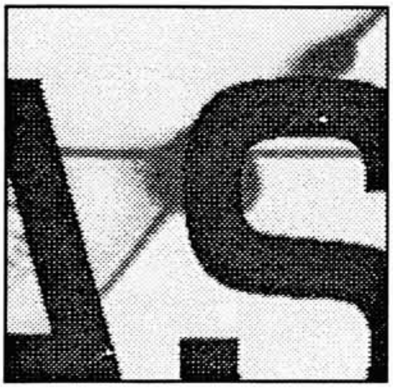


Figure 30

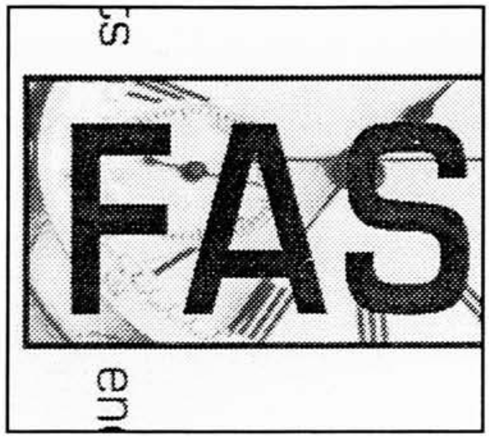


Figure 31

The next samples were printed on a 3M Rainbow 2720 dye sub at 300 dpi. They display text type and small type down to 3 points in size. Notice that the smallest type begins to loose density and definition, and characters display jagged edges. The loss of density and definition is a direct result of the dye sublimation process. In dye sublimation printing, the dye on a plastic film is heated by miniature heating elements on the printhead. The heated dye then momentarily turns into a gas which is absorbed by a special printing substrate. The gaseous form of the dye must jump across a microscopic gap in between the plastic film of the transfer roll and the substrate. Generally speaking, a higher concentration of gaseous dye will make a darker tone on the substrate. Lightened black densities of small text type are exactly the result of the opposite occurence. There is a very little amount of dye which has been heated to sublimate into a gaseous form and transfer to the substrate. This results in a naturally lighter color value which appears on the substrate. The main reason which such small text does not loose all density and definition is the advancement of dye sublimation technology regarding the transfer rolls and printheads of current model printers. Unfortunately, when the higher the definition of the text type at any size results in the appearance of the printer's true, lower resolution of 300 dpi. Look for the jagged edges and lightened 3 to 6 point type in the samples below (figs. 32 and 33).

Figure 32

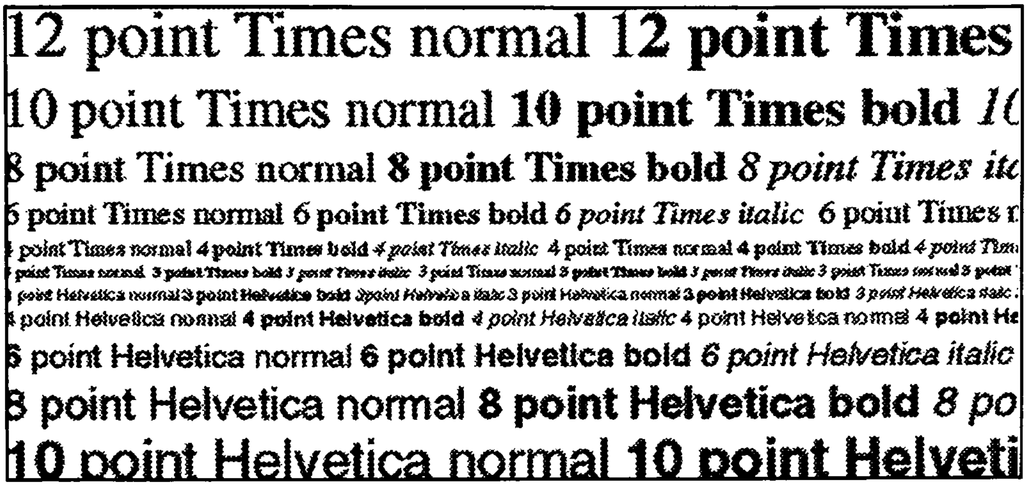


Figure 33

Color Laser with Halftoning

Many color laser printers have the advantage of printing at 600 dpi or 1200 x 600 dpi. Therefore all text and graphics benefit from the added resolution. In addition to higher printing resolution, certain laser printers take advantage of different screening processes. A screening process is the process used on any printed piece to create imagery and graphics. One of the three screening processes used by color printers and proofers is the halftone process which produces screens of dots for each one of the process colors. These screens are printed on top of each other to produce a process color image. With the exception of output from the Optronics Intelliproof, the screens of these dots are most often not the same screens common to the actual printing process (seen on the press sheet). Screens produced on a color printer or proofer are custom tailored to that specific color output device. They are created by a page description language such as Adobe

Postscript. Additionally some halftone based printers and proofers may be set in a continuous tone mode. This mode blends the edges of the halftone dots into each other to simulate a continuous tone photographic quality image. Note that more information on screening processes may be found in the *Proofing and Printing Process Supplement.*

The following two samples (figs. 34 and 35) were printed on a Tektronix Phaser 550 at 1200 x 600 dpi. The text in these samples is rendered with smoother diagonals and curves than previously seen in any of the other printing processes covered in the chapter so far. Serifs are well defined and sculpted as with the sharp and rounded ones which appear below. Text weight is also appropriate and has not been increased as seen in the phase-change output printed at the proportional 600 x 300 dpi of the Phaser 340.

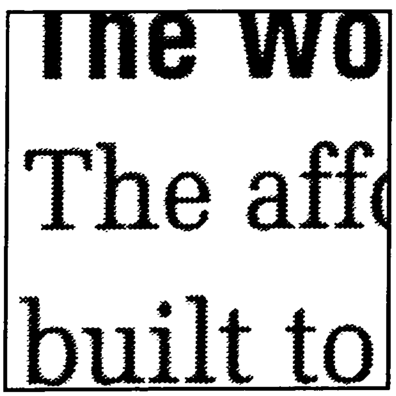


Figure 34

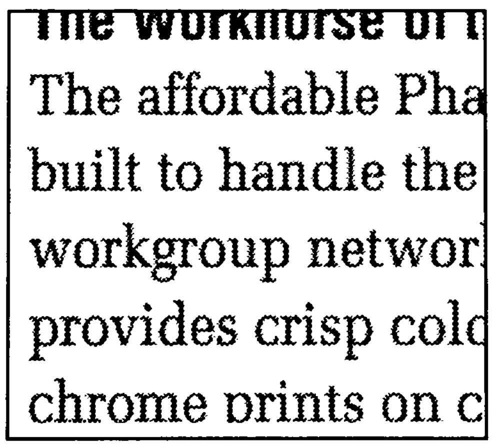


Figure 35

In addition to the text type above, the benefits of added resolution may be seen in the 8 point type below (fig. 36). The thin diagonal strokes of these sans serif letters have lost much of the jagged properties associated with all other color output processes previously displayed in this chapter.

Figure 36

The display type seen below has also benefitted from the added resolution. Even slight curves at the top of the letter "r" of the magnified view (fig. 37), or the letter "s" of the larger view (fig. 38) still display crisp strokes and stems. Additionally, harsh diagonals such as those found in the magnified letter "k" still do not have jagged or coarse edges.

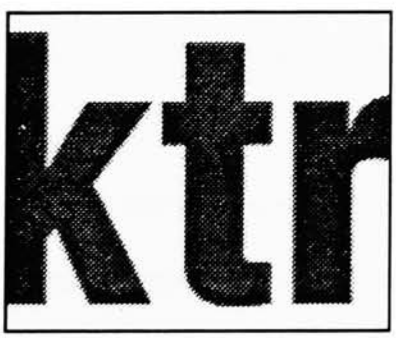


Figure 37

Figure 38

Color Lasers with Fixed and Variable-dot Stochastic Screening

The next screening process used by color laser printers is much newer to the graphic arts industry. Stochastic screening, or Frequency Modulated (FM) screening uses dots which are many times smaller than halftone dots. Using mathematical algorithms, these tiny dots are placed in the appropriate region (shadow, midtone, highlight) of the printed sheet in a random pattern. These random patterns of the process colors then create the imagery with very fine detail depending on the printed resolution. When used on press, stochastic screening shows no moiré and depicts an almost continuous tone image.

Color printers use stochastic screening in one of its two present forms: fixed-dot or variable dot. Fixed dot stochastic screening means that although the dots used to create imagery, graphics, and screened text are several times smaller than conventional halftone dots, they are all the same size. The variable dot stochastic process varies the sizes of these dots. Just like the conventional halftoning process, both fixed dot and variable dot stochastic screening affect only imagery, graphics, and screened text. The term *screened text* refers to text which is not printed in a solid color or solid black. Just as a screened spot color is created of halftone dots or stochastic dots which represent a lighter shade of that color, screened text is text which appears in a lightened shade of a color or black. For more information on halftone screening and stochastic screening, see the *Printing and Proofing Process Supplement* in the front of Chapter 5.

Examples of color laser printers which use both fixed-dot and variable-dot stochastic screening appear in Figures 39 through 42. Two of the following samples (figs. 39 and 40), printed on a QMS Magicolor CX at 600 dpi, have been created using fixed-dot stochastic screening. Figures 41 and 42 were printed on a Lexmark Optra C, also at 600 dpi, which uses variable dot stochastic screening. Notice that all four samples display text with the same smooth curves and diagonals found on output from other 600 dpi color and monochrome laser printers—*and* that even though these samples were printed with stochastic screening printers, the solid text of all four samples are neither better nor worse than a laser printer using halftone screening because screening technologies affect only imagery, graphics, and screened text.

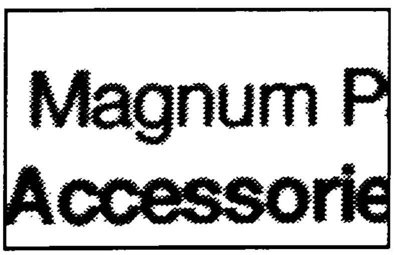


Figure 39

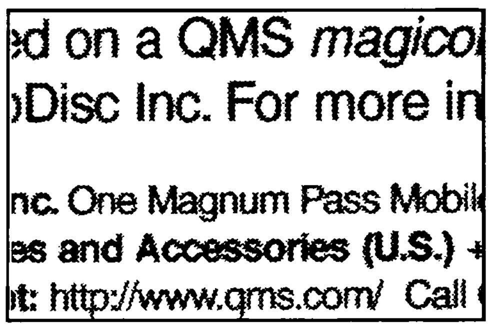


Figure 40

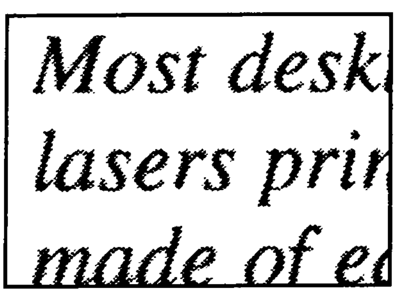


Figure 41

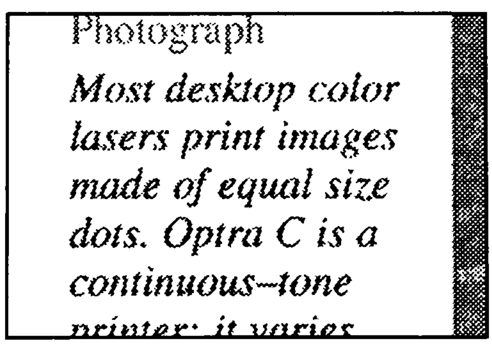


Figure 42

The final two laser printed samples below are of display type. Both were printed on the Lexmark Optra C. In the larger view (fig. 44), all characters are extremely smooth in definition. Character weight is also properly displayed. In the magnified view (fig. 43), all characters still possess smooth edges—even those of Tekton's thin strokes and stems.

Figure 43

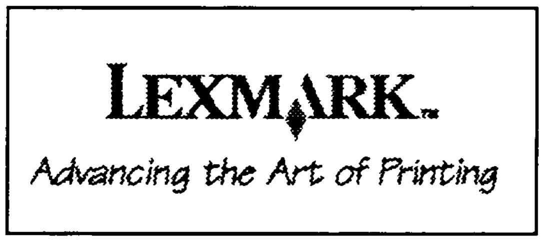


Figure 44

Text Samples of High-end Preproofers and Contract Viable Digital Proofers

CONTINUOUS INKJET

One of the most widely accepted contract viable, continuous tone proofers is the IRIS proofer, by Scitex. The IRIS's proofing process, explained in the *Proofing and Printing Process Supplement*, prints highly accurate color and continuous tone imagery. However, the IRIS only prints at 300 dots-per-inch. Therefore, its text and display type suffer from this low resolution. Although Scitex recently improved the rendition of type on its IRIS proofers, text type still displays the characteristic 300 dpi jaggedness found in other output printed at the same resolution. However, despite coarse curves and diagonals of Figures 45 and 46, text weight is properly displayed, details finely modeled, and serifs are well defined.

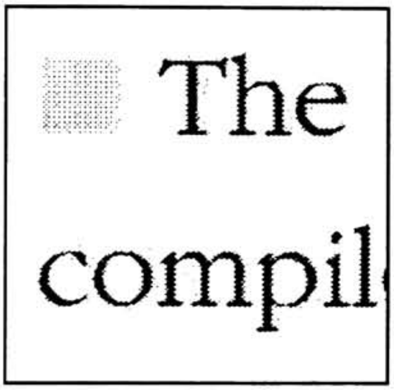


Figure 45

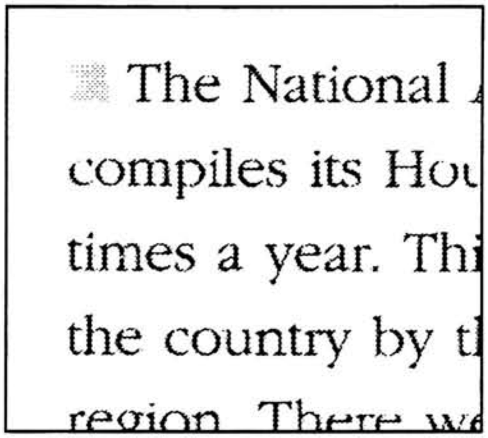


Figure 46

The following samples of display type (figs. 47 and 48) are also show finely detailed letters. Curves are smoother than in the text sizes. Character weight and density are also properly shown.

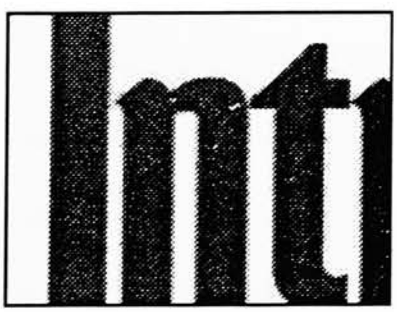


Figure 47

Figure 48

Dye Ablation

The Kodak Approval system is the only digital proofer which prints at extremely high resolutions. The following samples (figs. 49 and 50) were printed on an Approval system at 1800 dpi. Notice the extremely smooth curves of all letters. Near perfect rendition of serifs and character weight is also present. These two samples are similar to what will actually appear on the final press sheet.

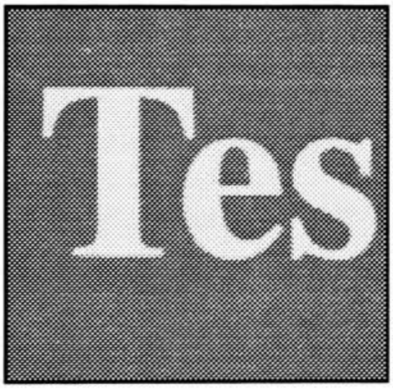


Figure 49

Figure 50

Section 2: *Mixing Type and Color*

Most all of the samples shown in this chapter consist of black type on a white background. Of course typography is not limited to black and white design composition. Colors are used freely throughout modern design typography. At times, colored typography is very difficult to print due to registration problems. When a design contains very small, process colored serif type, the slightest bit of misregistration on press will send one or more of the process colors leaking off the sides of every letter in the design. In regards to color proofing and printing, misregistered, process color type is not of any concern. Because color printers and proofers print with practically perfect registration, even the smallest process color letters will not be affected by misregistration. They can, however be affected by other printing or proofing process attributes.

As all color output devices combine two or more process colors to display imagery, graphics and colored text, the resolution and process of the printer or proofer directly affect the quality of very small sized elements. Often, the serifs and entire letterforms of small text are the unfavorably affected targets of lower quality printers and preproofers. For example, a liquid inkjet printer at 300 dpi can produce only limited size color dots to reproduce imagery. The size of that dot, which must be combined with another (except in the cases of c, m, or y colored type) to produce process color type, may be the size of the entire serif on any given letter of the alphabet. When that serif is printed, it receives no modeling or rendering by halftone patterns. Rather, the serif becomes a circular or ovular dot of ink with no sharpness at all. Additionally, if the letters are small enough, they may be displayed just as the serif in the previous example. Entire letterforms may become indistinct groups of halftone dots displaying no similarity to letters at all. These two types of effects occur most often on low-cost, 300 to 400 dpi liquid inkjet printers, thermal wax printers, and phase-change inkjet printers.

Other effects which may appear throughout small, process color type include increased text weight and color inaccuracy. Increased text weight is the result of combining process colors on a low resolution printer to display colored type. As more than one process color must be printed to produce small, colored text type, the effects of the previous paragraph may occur in addition to the display of overall larger letterforms due to the size of the halftone dots being overlapped. Color inaccuracy is the result of the dissimilar color gamuts of the color printer or proofer and the actual press inks. As with the previously mentioned problem of small text definition, reduced color gamut and increased text weight is most often seen on low-cost, 300 to 400 dpi liquid inkjet printers, thermal wax printers, and phase-change inkjet printers. Inaccurate color due to too wide of a color gamut is most often seen in continuous inkjet proofers such as the Scitex IRIS or DuPont Digital Waterproof.

Color Primer

General Color Knowledge

Color Primer

Additive and Subtractive Color Theory: How the Colors of the Spectrum Create An Image

To understand why the color output of all preproofers and proofers may never exactly match the images seen in real life or even those on a printing press, it is important to become familiar with the basics of additive and subtractive color theory. These theories demonstrate how transmitted and reflected light are seen by the human eye.

Additive Color Theory

All of the colors of light which are transmitted directly to the human eye may be explained by additive color theory. The additive color theory uses a combination of varying intensities of the primary colors red, green, and blue to create imagery. If all three colors are added together at their brightest intensity, they produce white light. To explain how additive color theory works, the example of a television will be used. When observed very close up, one sees small dots—in groups of red, green, and blue—glowing inside of the television's cathode ray tube (CRT). When a picture is displayed, the television varies the intensity of these groups of dots. From far away, the eye does not resolve the individual dots and these RGB groups each produce a specific color. When combined, they create the image being displayed on the CRT. Note that none of the dots are overlapping to produce the final image.

Some examples of the transmitted light used in additive color theory include that which is seen when viewing color transparencies on a light table, and any light from light sources which is projected directly into the eyes. Additive color theory does not explain colors which have been reflected off of objects and into the eyes. The drawback of the additive color theory, and why its system is not used for the reproduction of color imagery, is its requirement of high-intensity illumination to produce whites and colors of acceptable brightness (Field, 12). A simple diagram (fig. 51) illustrating additive color theory when all three colors are at their brightest intensity, shows the combination and resulting colors of the primaries red, green and blue. Note that the secondary colors cyan, magenta, and yellow are each composed of two of the primaries.

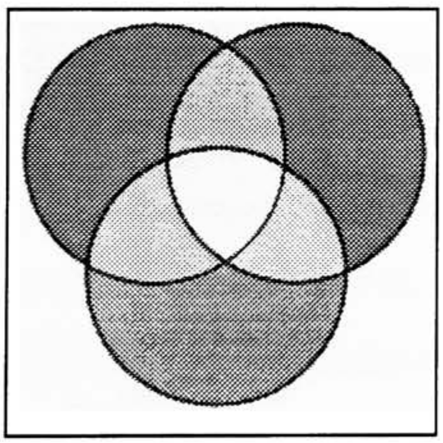


Figure 51

Subtractive color theory, that which is used to create printed imagery and photography, is based on the secondary colors of cyan, magenta, and yellow. Any colors we see due to light which has been reflected off of an object may be conceived with this theory. Ideally, the subtractive color theory and its system are based on light which has been reflected off of a white object. In regards to printing and proofing, non-ideal situations arise when the object upon which the printing or proofing will occur is not white substrate. An example might be a colored, recycled paper which may still be light in tone, but is not white.

The subtractive color system may be explained in the following manner. The beginning of the subtractive system involves a white surface such as white paper which is lit by white light. The reason the paper appears white is that it reflects all of the colors of the visual spectrum. The visual spectrum is made up of wavelengths of electromagnetic energy which is measured in nanometers. Its white light is composed of wavelengths which appear as the following colors to the human eye: red, green, blue, cyan, magenta, and yellow. The spectrum below (fig. 52) shows each of the colors as they blend into each other. Notice that the labeled wavelengths of the spectrum measure between 400 and 700 nanometers (nm).

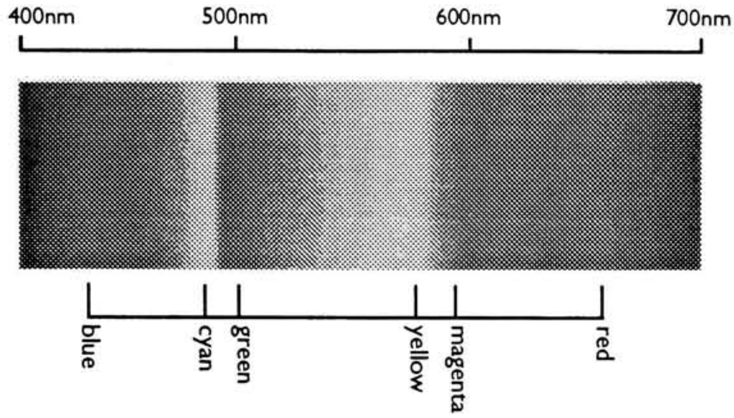


Figure 52

To create an image on the paper, combinations of various intensities of red, green, and blue light are needed. To vary these intensities (just as the television set does), one must subtract the opposite colorants on red, green and blue. These opposite colorants are cyan, magenta, and yellow. Red's opposite is cyan, while green's opposite is magenta, and blue's opposite is yellow. To perform this subtraction and vary the intensities of reds, greens, and blues which are reflected off of the paper, the printer places halftone dots of cyan, magenta, and yellow onto the paper.

A simple diagram of the subtractive color theory is shown below (fig. 53). Notice that when all three secondaries are overlapped, they subtract from the substrate its ability to reflect any light at all, hence the color black is perceived by the human eye. Unfortunately, printing inks are not perfect due to the pigments and chemicals they use to create their colors of cyan, magenta, and yellow. Because of this, they do not subtract all of the reflected light which is passing through them.

The result of imperfect inks is a black which lets some light pass through it. It appears as a dark, somewhat brownish tone. In printing, an additional black ink is added as a halftone screen to darken these imperfect blacks. Blacks are represented by the letter "K" in the C M Y K abbreviation so it is not confused with the letter "B" for blue.

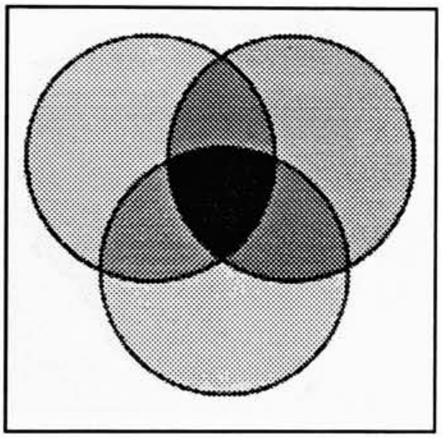


Figure 53

Unlike the additive color theory applied in the example of the television set, the dots of cyan, magenta, yellow, and black may overlap. When any two of the secondaries (CMY) overlap, as shown in Figure 53, one of the primaries is created. As a result, the printing process which uses subtractive color theory is much more complicated than the additive process used in the example of a television set.

In a color reproduction, there are as many as eight image elements created by the printing and overlapping of cyan, magenta, yellow, and black (Field, 14). These eight elements are halftone dots of R, G, B, C, M, Y, and K. As before in the example of additive color theory, the eye no longer resolves individual dots of any of these colors at the proper viewing distance. An example of halftone screening using all of the eight color image elements may be seen in Figure 54. In the distance, the dominant color of the image is a fleshtone of the woman's face. However with this magnified view it is possible to examine the individual color elements as well.

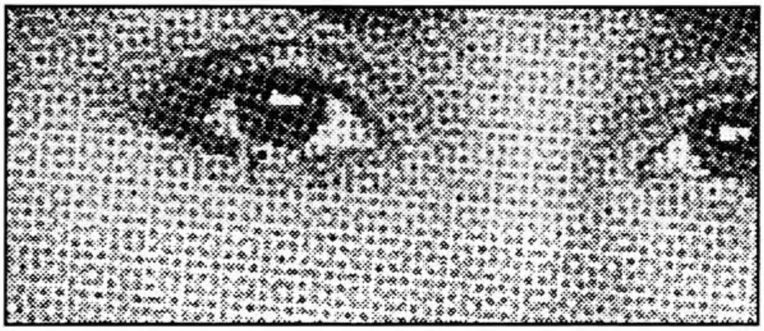


Figure 54

As mentioned before, printing inks and their pigments are not perfect. Along with the imperfect blacks that they create, they also cannot reproduce past a certain number of colors. The range or number of colors a set of printing inks (CMYK) can reproduce is called its color gamut. The dyes and pigments used in color printers and proofers also have a specific color gamut. Here lies the reason which digital color output devices may not be able to display the amount of colors seen in real life, on photographs, or on the printing press. Neither the color gamuts of printing ink pigments, nor those found in printers and proofers are able to represent all of the colors seen with the human eye. Additionally, some printer and proofer colorants display a smaller or larger color gamut than those of printing inks.

Color Gamut

In order to further explain the idea of a color output device's color gamut, this section presents information about industry standards pertaining to the measurement of color and how it is perceived by the human eye.

COLOR SPACE: DEPENDENT AND INDEPENDENT

Through the eyes, an image and its color quality are observed and measured by a very subjective analysis. For the purposes of proofing and printing, color must be able to be measured mathematically without the subjective opinion of the eyes. As mentioned before, all colors of light are made up of electromagnetic energy which exists in the form of wavelengths throughout the visible spectrum of light. These wavelengths are measured in nanometers. Each color may be given a mathematical value according to its wavelength or combination of wavelengths. When all of these wavelengths are emitted simultaneously from a light source, or reflected off of a surface, the human eyes perceives white light. To classify different combinations of wavelength(s), the mathematical values of millions of colors may be grouped into a *Color Space*. For proofing or printing purposes, a Color Space describes and organizes colors on a set of mathematical axes in order for it to be communicated from person to person or from one workstation, prepress or press related device to another (QMS, 1996).

Color spaces help quantify, measure, and translate a color's mathematical information between workstations and prepress devices when the resulting printed color values *are* dependent on a specific device or when they are *not* dependent on a specific device. When the accuracy of a color space's color information is dependent on a specific device, such as a printer or proofer, it is called a Device Dependent Color Space. This means that its color information, originating on a set of mathematical axes, requires a specific output or viewing (such as a computer monitor) device to display color correctly. An example of a device dependent color space is that which encompasses colors created out of combinations of cyan, magenta, yellow, and black. Every device which prints CMYK colors prints them with different inks or dyes. Thus a different set of mathematical information is required for every device which uses a different output process and/or set of inks, dyes, wax, or toner.

When the accuracy of the color information provided by a color space is not dependent upon a specific workstation or output device, it is called a Device Independent Color Space. Except for the reds, greens and blues displayed on monitors, for each monitor is different and displays color differently, the RGB color space is considered to be a device independent color space.

CIE Color Space

In 1931, the Centre Internationale de L'Eclairage (CIE) was the key organization which began to establish methods for the measurement of color as it is perceived by the eyes. The CIE methodology and measurements of color became the industry standard of device independent color space. These standards allowed everyone in the graphic arts industry to communicate, through particular coordinates on a three dimensional graph (a coordinate on each of the *x*, *y*, and *z* axes), the information specific to any color visible to the human eye. This standard, device-independent color space became known as the CIE x*y*z Standard Observer. Later in 1978, two more standard, device-independent color spaces were defined by CIE. One, entitled CIE L*a*b, was aimed at describing small differences in color measurements such as those displayed on a computer monitor with millions of colors. The other, entitled CIE L*u*v, was intended to describe the larger differences in color measurements found in the color gamuts of inks and dyes used for color reproductions (Field, 57). The larger differences in color measurement are the result of the ability of printing colorants to show only so many colors—they show only thousands, in comparison to the millions displayed on a monitor or as seen by the eyes. A general model of the CIE color space graph may be seen in Figure 55.

CIE Colorspace Chromaticity Diagram

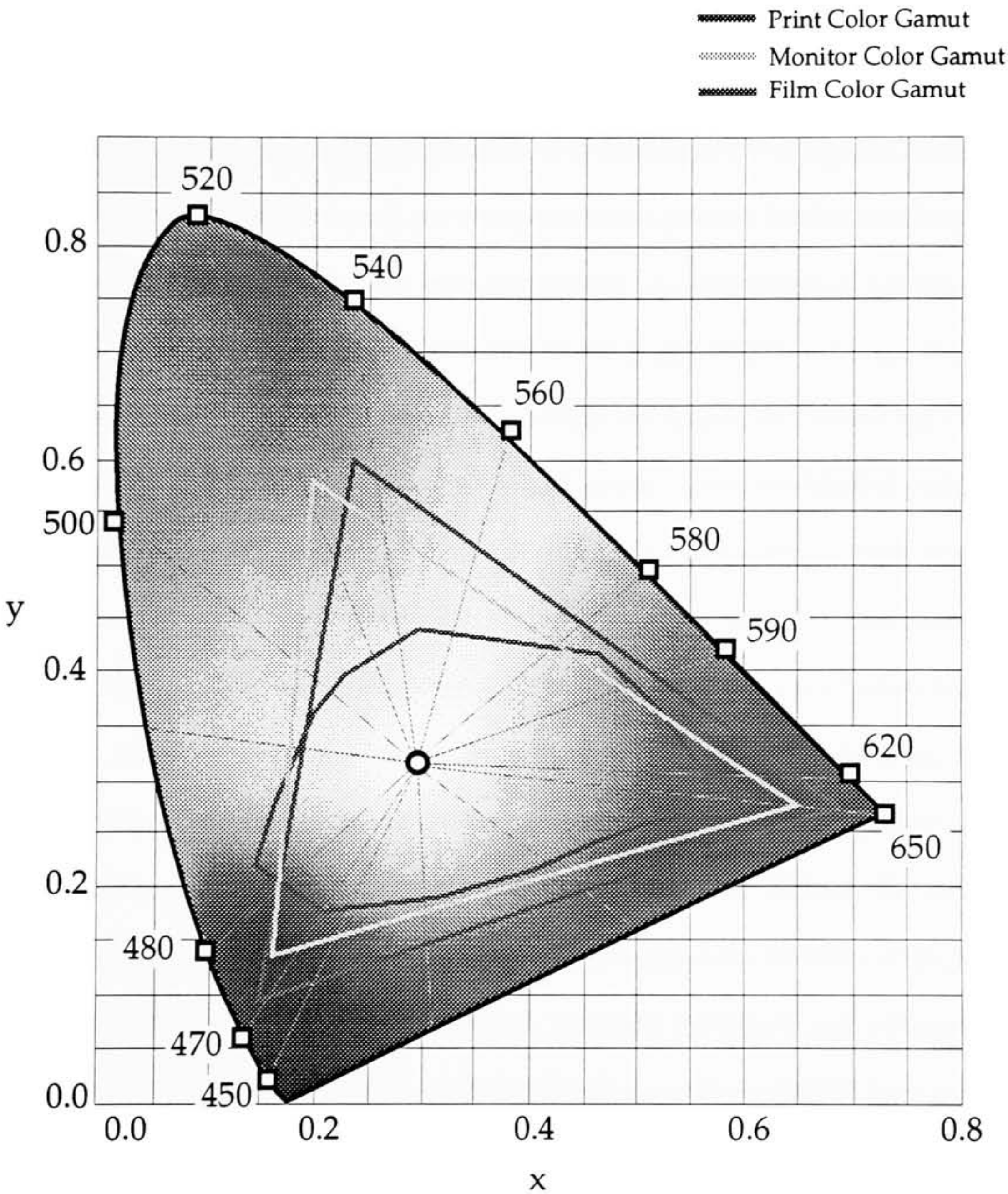


Figure 55

Entitled a chromaticity diagram, this model is a mathematical representation of the *hue, saturation,* and *lightness (tone)* of color as the human eye perceives it. It is based on the temperatures of light in degrees Kelvin. The color of light according to its temperature may be referenced to the Black Body theory explained in a latter section of this chapter entitled *Proper Lighting*.

It is easiest to envision the graph in three dimensions by using the following thought process. First, the *x* and *y* values have been plotted in the usual style of any two dimensional graph. The resulting points are indications of the hue and saturation of the color. The third dimension of the graph and its color can be visualized as numbered points on the outline which are suspended above the rest of the diagram (Field, 54). The grey lines which stretch from the labeled points of color temperature to the center of the diagram are simply for visual reference. The numbers labeling the square points are temperatures of light (measured in degrees Kelvin). The higher the temperature, the lighter the grey value/tone of the color. A lighter color may also be thought of as being suspended higher above the diagram. The highest point on the diagram, which has the lightest value (white), is located in the center. Its color temperature is 5000° Kelvin. The color of a 5000° K light source represents daylight to the human eye. To view color prints and proofs, as well as final reproductions, prepress providers and printers use light sources which emit the same 5000° K light. Known as the D5000 light source, it has become the viewing standard for the graphics arts industry.

Color Gamut of Proofing Processes on CIE color triangle

Labeled on Figure 55 are three different outlines of color gamut. The color gamuts of photographs and monitors are very similar. They contain a much broader range of color than that of the printing process (QMS, 1996). In regards to digital proofing, the color gamut of the printing process is the closest to the range of colors which may be produced with all color printers or digital proofers.

Most all digital output devices can produce a range of colors inside of the color gamut shown for the printing process. The following is an ordered list of color gamut capability according to the color output process used—the larger the number, the larger the color gamut of the digital output device. Note that only one process exceeds the color gamut of commercial printing: continuous inkjet.

1. Thermal Wax
2. Liquid Inkjet and Phase Change Inkjet
3. Dye Sublimation
4. Dye Ablation
5. COMMERCIAL PRINTING – OFFSET LITHOGRAPHY
6. Continuous Inkjet

Those output devices which do not begin to approach the color gamut of commercial printing, such as thermal wax printers, liquid inkjet printer, and phase change inkjet printers, are not currently accepted by the graphic arts industry as contract proofers due to their failure of color gamut reproduction. Dye sublimation, continuous inkjet, and dye ablation proofers are accepted as contract proofs depending upon the cost of the job at hand. Note that when continuous inkjet proofs are accepted as contract proofs, one must be extremely careful not to over-shoot the possible color gamut of utilized printing process.

Common Color Measurement Tools

During the prepress and production process, the color gamut of digital proofers must be calibrated to the press upon which a job will be run. The following tools are those used to measure the qualities of light and its color, as well as the densities of the process color inks. In order to understand they basic methods two of the following tools use to mathematically quantify color, one must become familiar with the definition of a Spectral Power Distribution Curve(SPD). A SPD curve is the true fingerprint of a light source and its color. Depending upon the increments of nanometers with which a light source has been examined (the more points, the more accurate the SPD curve's fingerprint), a SPD curve displays the relative proportions of each color of the spectrum which appear in the examined light source. An example of a fluorescent light's spectral power distribution curve is displayed in Figure 56.

Spectral Power Distribution Curve—Fluorescent Light Source

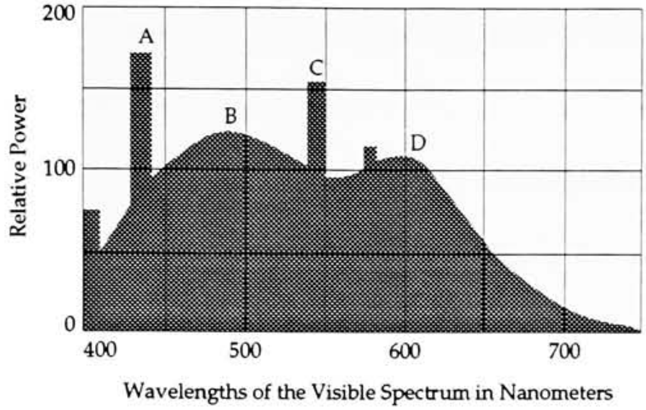


Figure 56

According to this figure, a fluorescent light source has high concentrations of cyan colored light (B) and high concentrations of magenta colored light (D). The spectral "spikes" of fluorescent light occur in the dark blue range (A) and the greenish-yellow range (C). Spectral spikes are simply large concentrations of a specific color of light in an illuminant. Spikes in a SPD curve occur numerous light sources. Note that only specific light measuring tools such as a spectroradiometer measures the content of a light source accurately enough to detect these spikes.

A spectroradiometer is the most accurate of all color measurement tools. It measures emitted, not reflected, light. However, they are extremely expensive and not used by many printers or prepress providers. The above SPD curve was plotted with measurements of fluorescent light taken by a spectroradiometer. In addition to SPD curve of a light source, spectroradiometers also measure the correlated color temperature of a light source. This temperature is related to the color temperatures on the CIE Chromaticity diagram seen earlier in the *Color Primer.*

For example, the temperature of 450° K shows a deep blue-purple on the diagram. The chromaticity values used to plot the CIE diagram were all calculated with a spectroradiometer as well.

The next, more common color reading instrument is called a spectrophotometer. Essentially, it is capable of creating the same measurements as a spectroradiometer when these measurements correspond to reflected rather than emitted light. Spectrophotometers are used to measure the chromaticity values and spectral absorption curves of color on color swatches of ink or dye. A spectral absorption curve is similar to a SPD curve, but makes measurements across the spectrum for the colors of light that are absorbed (not reflected) by the color swatch being measured.

A more economical version of the spectrophotometer is the colorimetric meter, more widely known as a colorimeter. A colorimeter takes readings similar to those of a spectrophotometer. However, a colorimeter is less accurate for it makes its measurements at only three points in the visible spectrum. These three points are at the wavelengths of red, green, and blue measured via a set of color corrected filters (one each of red, green, and blue). Due to the ability of a colorimeter to only measure a reflected light at three points across the spectrum, its measurements can be thrown off by the spikes seen in a SPD curve if they occur at places besides the three chosen sample points of red, green, and blue (Hamilton and Saleski 1994, 19).

The last common measurement tool to become familiar with is the densitometer. Densitometers do not read the colors of light. They measure the density of colored or black inks on a printed page or transparency. Densitometers come in two forms. One type reads the density of transparencies and film, while the other is for strictly reflective subject matter such as a press sheets, conventional proofs, or digital contract proofs.

COLOR MATCHING SYSTEMS

There are several color matching systems commonly used with desktop workstations. The most common being the Pantone Color Matching system. Others include the Focoltone Colour System and the Trumatch system. Each color matching system provides ranges of custom ink spot colors and/or process color combinations. All process color combinations are based on international process color ink standards such as those created by the Magazine Publishers Association (MPA) entitled Specifications for Web Offset Publications (SWOP) or Specifications for Non-Heatset Advertising Printing (SNAP). These guidelines include information regarding the formulation of industry standard process color inks with specific hues, saturation, and lightnesses. Information about SWOP or SNAP standardized process color ink sets enables the ink manufacturer or printer to produce and/or utilize inks for specific printing processes which will produce a standardized color gamut.

Using these standards, the manufacturers of color matching systems include digital information defining their sets of custom colors with design tools such as desktop workstation-based illustration programs, pagination programs, and photographic manipulation programs. This information is provided for use with multiple computing platforms such as the Apple Macintosh, IBM compatible PCs, and others Color Electronic Prepress Systems. Additionally, some manufacturers, such as Pantone, have introduced their own color management applications for use with the creative and production process.

In parallel with the above digital information are the equally important swatchbooks containing the same custom colors. These colors are printed on a sample substrate. They are usually printed on white, coated and uncoated stocks. Color swatches provide the designer with choices of spot colors that she or he knows may be reproduced. Custom colors may be chosen through swatchbooks and later found on the desktop creative workstation in a number of programs. Once found, the designer may apply them to the project at hand while being reassured of the success of a custom color's replication during the printing process.

The Pantone Color Matching System is the largest matching system available to the graphic arts community. The system is comprised of over 1000 specified spot colors and more than 3000 process color combinations that may be used to generate simulations of any Pantone spot color. The Pantone system provides hand held color swatch guides as well as digital versions of all of their solid spot colors or process color equivalents. These guides show the user printed versions of all true Pantone spot colors and how close one may come to reproducing any of the available spot colors through use of process color printing. Pantone is also the first color matching system manufacturer to produce an application-independant color management software which works with most any desktop publishing workstation—Pantone ColorDrive (Pantone, The Power of Color, 1996).

The Focoltone Colour System is produced in Great Britain. All Focoltone colors may be produced by a set of standardized process color inks—no custom ink colors are available. There are 763 Focoltone custom colors in all. These colors have been created and arranged using a patented system of process color combination. Advantages of the Focoltone Colour System is its available hand-held computer and computer software which compensates for a specific printing process' dot gain characteristics. The major disadvantage to the Focoltone system is its limited amount of available colors (Focoltone, An Introduction, 1990).

The Trumatch color system is comprised of more than 2000 achievable, computer created process color hues. As with other color matching systems, the Trumatch system includes a series of process color grays as well. The Trumatch system is available in the form of hand held color swatch books.

Chapter Three

Proofing for Imagery

and Color

Chapter 3: Proofing for Imagery and Color

Direct Effects on Image Quality

Repeatability and Proofer and Printer Maintenance

Throughout this chapter, various factors which affect proof and print imagery are explained. Most have to do with lighting and viewing conditions. However, one of the first and most simple factors which can affect proof and print imagery is the maintenance of all digital output devices. Maintenance and proper care of a printer or proofer directly affects its performance and image quality. Some lower cost output devices, such as liquid inkjet printers, require much less maintenance in accordance to their "ease of use" factor and printing process. While most mid-range color printers do not require more complex maintenance by the user, their printing processes are more complex. A more complex output device process requires more skilled maintenance during possible printer breakdowns. Therefore a service representative may be involved. But for the most part, devices such as phase-change inkjet and thermal wax printers require only the replacement of their ink or wax cartridges. Higher end devices, such color laser printers, have a much greater need for user maintenance. There may be as many as 11 different consumables to replace on the typical color laser printer. This greater number of consumables is due to a color laser's more complex printing technology. Some of these include four toner cartridges, four developer cartridges, and the photoreceptive drum or belt (Tektronix, Bright Ideas, 1996).

Whichever the case of user replaceable consumables, they all affect output quality. As the colorants in the toner or ink cartridges deplete, so do the densities of text, and saturation of graphics and imagery. Additionally, as parts become dirtied, image quality and color will also display dirty or dull characteristics. For example, as the printheads of thermal wax printers or liquid inkjet printers dirty, imagery may show banding (stripes or uneven image tonal quality).

Another example of uncleanliness affecting image quality occurs with color laser printers. As the photoreceptive drum of any color laser device becomes dirty, color casts over the entire printed sheet may occur. When a drum becomes dirty, it does not properly print a color separation. As color lasers must make four passes over the substrate to print the image (one each for CMYK), one pass with a dirty photoreceptive drum leads to some of the toner from that pass sticking to the drum—instead of *all* the toner adhering to the substrate. This toner is then mixed in with that of the next separation. For example, if a color laser printer images the yellow separation with a dirty drum, some of the yellow toner is left on the drum to be mixed with the following process color. This results in a yellow color cast on the following separation.

Mid-range and high-end preproofers and proofers do not usually require very much user oriented maintenance. Some devices, such as the IRIS 3047 continuous inkjet even have self cleaning features. However, these features and those of other output devices such as the Xerox Majestik color laser copier, DuPont Digital Waterproofer, or the Kodak Approval require maintenance by a skilled technician.

Because of their higher color and image qualities, it is extremely important to establish a regular maintenance schedule for any mid-range to high-end output device.

All of the considerations above, for both color printers and digital proofers, relate to achieving print repeatability. Aside of the desired color quality which may be achieved on different printers and proofers, the next most important factor which affects imagery is an output device's repeatability. As mentioned in Chapter 1, the repeatability of an output device is a measure of its ability to repetitively print consistent, applicable quality output in regards to text, graphics, imagery, and color. By maintaining an output device with regularly scheduled maintenance checks, one achieves the ultimate in output repeatability.

Proper Lighting: An Essential Part of Viewing Proofs and Prints

One of the most crucial factors which influences the appearance of imagery and graphics on the output of all printers and proofers, is the light source under which they are observed. Although strict viewing and lighting conditions apply more to the observation of contract proofs, even the colors and imagery of preproofs may be more clearly seen under proper lighting and within the proper surrounding environment.

The following sections pertain to the proper viewing of prints and proofs. Included is information which should become common knowledge to the viewer regarding the light sources used for these purposes.

Metameric Colors

If two different monochromatic objects, such as a pair of blue pants and a blue shirt, match under one light source, but do not match under another, the two colors of blue are said to be a metameric match. Metameric colors may match under incandescent and halogen lamps, but not under fluorescent lamps—or vice versa. They may even match under a prepress provider's viewing booth and room lighting, but not outdoors. Metameric colors appear similarly and differently under several different combinations of separate light sources. Metamerism may also occur is a case where one or more viewers of a color see that color differently than another viewer sees it under the same light source. This is called observer metamerism (Hamilton and Saleski 1994, 17).

In whichever situation a metameric color is observed, or thought to be observed by different viewers, the concept of metamerism highlights the importance of a constant light source while viewing proofs, prints, or transparencies. By having a constant light source which is used to view artwork throughout the entire graphic arts industry, much confusion and many of the questions raised about color accuracy and quality are avoided during the creative and production process.

Black Body Theory

The concept of standard lighting is based on the color temperature of a utilized, standard lightsource. A color's temperature is a way to describe a specific light source. The term *color temperature* is related to actual temperature in the following manner. One must first become familiar with the basic definition of a black body. A black body is a theoretical, hollow chamber whose color depends on its temperature rather than its composition (Hamilton and Saleski, April 94). When heated to extreme temperatures, a black body changes color. Unheated, a black body's color is black. As its temperature rises, its color changes from a dull red to a brilliant white. At a temperature of 5000° Kelvin (0° Kelvin is equal to -273° Celsius), or 8400° Fahrenheit, a black body displays a balanced white light which is equivalent to the light that the human eye perceives as daylight. The color balance of a 5000° K light source is its most important feature. A light with the color temperature of 5000° K contains nearly equal amounts of the primary bands of the visible spectrum—red, green, and blue. This type of light source is ideal for viewing artwork and graphic reproductions due to its color balance. With a near perfect color balance, all hard copy which is viewed under such a light source is neutrally illuminated.

Neutral illumination is a catalyst for the correction of truely incorrect colors because no color under scrutiny has been influenced by an excess amount of a one or more colors in the spectrum. For example, a blue color on a proof which has been previously observed under a color balanced illuminant will appear as a deeper, blueish green under the unbalanced emissions of a fluorescent lamp. This is due to the lamp's excess amounts of blue and cyan colored light.

The 5000K Light Source Standard

In the 1960s, the American National Standards Institute (ANSI) developed standards for the color temperature of the most common, industry-wide illuminant under which artwork, proofs, and press sheets are viewed—the D5000 light source. A D5000 light source displays the color temperature of a black body at 5000° K. The letter "D" stands for daylight, as a D5000 illuminant simulates what the eyes perceive as a bright, sunny day. As explained in the previous section entitled Black Body Theory, the advantage of the D5000 lightsource lies in its color balance. All materials viewed under it are neutrally illuminated. Therefore (when it is used as an industry wide lighting standard) it is ideal for spotting color and imagery inaccuracies.

Viewing Conditions at the Studio, Prepress Provider, and Press

In order to view artwork, prints and proofs, or compare proofs to the printed piece, consistent viewing conditions are mandatory. Wherever a proof or print is viewed, whether it be at the designer's studio, prepress provider, or on press, viewing conditions should be the same. If the viewing conditions and environment differ, color and imagery qualities may be affected undesirably.

Environment Surround and the Viewing Booth

There are several qualifications which must be fulfilled in order to obtain consistent viewing environments at all three observation sites—the studio, prepress house, and press. The first consideration regards the size and dress of the room in which a viewing booth is placed. A viewing booth consists of a D5000 equivalent light source for viewing reflective copy and a backlit viewing box with the same light source for viewing transparencies, both of which have been placed inside of a neutrally grey painted construction. Although the booth has its own internal neutral grey surround, the room in which it is placed, must also be neutral grey. This room should be lit by a balanced light source at a lower intensity than that of the viewing booth's. There should be no other objects in the same room besides the booth. Other objects reflect colored light and may have a varying amount of influence on the artwork, proofs, or press sheets under scrutiny. Also, the size and dimensions of the viewing rooms at all three locations should be the same if at all possible (Carr 1995). With rooms of similar size and dimension, the amount of reflected light in the viewing environment will be the same (as long as all light sources are the same).

Of course, the presence of colored items in the viewing booth, besides the copy being observed, should not be allowed. Just as light from colored objects in the viewing room may affect the appearance of copy, so will objects inside of the viewing booth. Even the smallest objects, especially if brightly colored, will affect the appearance of copy and the opinion of the viewer or viewers.

The Human Factor

Viewing prints and proofs is always a subjective matter. Opinions regarding color accuracy and image quality differ from person to person. Standard viewing conditions were created for the purpose of narrowing such differing subjective opinions. However, standard viewing conditions only go *so* far. There are several human factors which influence the subjective appearance of copy.

Memory Colors and Multiple Viewers

The most apparent human factor which affects the way one perceives all color copy is the factor of *memory colors.* Memory colors are those object colors which the mind tells us should have a certain appearance. Examples of memory colors are the greens of grass, the reds of apples, the blues of a sky on a bright day, and (the toughest to decipher) fleshtones. The human eye, all of these should appear a certain way. However, different people have different opinions regarding the appearance of memory colors. If there are several viewers debating the color accuracy of a proof, it is of extreme importance that they agree upon the validity of the memory colors which appear in the examined copy.

Artwork and Photographic Borders

Another influential human factors which affect the appearance of copy is the eye's tendency to view artwork, prints, and proofs with dark borders as ones which have more contrast and brightness. Meanwhile, copy with light colored borders tend to display less contrast and brightness (Field, 52). When viewing artwork which has been mounted on posterboard, it is important that the mount be neutral gray in color. Otherwise, the copy may appear to have too little or too much contrast. When viewing transparencies with black borders due to film, it is important for the viewer to keep in mind the effects of a black border on imagery. In other words, he or she must mentally compensate for any added contrast caused by the dark border around the photographic image. An example of the influence on copy in regards to light or dark borders may be seen in Figures 57 and 58.

Figure 57

Figure 58

OBJECT COLOR IMPORTANCE

Another human factor which may directly affect the way color and image accuracy is perceived is the group of decisions made during the observation of copy regarding the importance of compositional element color accuracy. Since there are many times that the utilized printing process cannot achieve sufficient color accuracy for all of the objects in a composition, compromises must be made regarding which elements require the greatest color accuracy. According to the viewer(s), objects which require a higher degree of color accuracy must be singled out. It is important that all viewers agree upon which elements require this accuracy. If not, then adjustments in the prepress and printing processes will not be carried out to achieve the highest quality reproduction which is attainable by the utilized printing process.

Other Human Factors

Some other human factors which affect the way one perceives color include the adjustment of eyes to a lightsource and waking time. When viewing prints, proofs, and reproductions under the proper lighting conditions, one must allow the eyes to adjust to the light source. It only takes a few minutes for the eyes to adapt to a darker, lighter, or more balanced lighting condition. If one does not allow for this adjustment, then their opinions regarding accurate color will change as the observation process takes place (Carr 1995).

The other factor mentioned above is waking time. There are several instances when a press run must be evaluated during the night hours or early in the morning after sleep. When comparing proofs to press sheets after waking from sleep, the cones and rods of the eyes may require as much as an hour to perceive color in the same manor as they do during the day. It is important to allow for this waking time before approving or observing the progress of press runs or the accuracy of individual proofs.

Simulated Spot Colors and Duotones

As mentioned in the first chapter, all spot colors which are displayed on color printers and digital proofers are simulated using the four process colors. Duotones which are made up of one or more spot colors, are also displayed using the four process colors. It is important for the designer to note that unless spot colors (for the purpose of duotones or not) are added to the printing process, they will always be simulated using cyan, magenta, yellow, and black. In fact, most pixel based programs may let the user choose a duotone mode for creating duotones, but for printing and proofing purposes the files created in these modes are changed into process color modes by the prepress provider. Additionally, the designer should also be aware that PostScript, the most popular desktop workstation page description language does not allow for the blending of two spot colors. Whichever the case, spot colors and duotones will be simulated by color printers and digital preproofers. Therefore it is good practice to become familiar with which spot colors of a given color matching system are changed more than others when simulated by process color printing and proofing.

Noting a Color Matching System's Limitations

As mentioned above, since all printers and proofers simulate spot colors using the four process colors, it is good practice to become familiar with which spot colors of a specific color matching system suffer more from being simulated. With many software packages, such as those provided with Electronics For Imaging's (EFi) Fiery software-based RIP which connects to a color laser copier, the user is given the ability to output color swatches which simulate the colors of a specific color matching system. In the case of EFi's Fiery, the matching system used is the Pantone Color Matching System. By printing all of the swatches available through the given Pantone Matching System, one may evaluate the accuracy with which a specific color copier simulates spot colors. Just as with adopting proper viewing conditions in regards to the observation of color imagery, it is important that these output swatches be viewed in a viewing booth with a neutral gray surrounding environment. Outputting (and properly viewing) color swatches for a utilized color matching system on any color printer or digital proofer will enable the viewer to accurately note the limitations of a specific color output device in regards to its ability to simulate spot colors.

Attempting to Match Simulated Spot Colors and True Spot Colors

It is often necessary to proof spot colors for designs which consist of only two to three colors, or those which use process color imagery and require an extra spot color for specific graphic elements such as corporate trademarks. Currently the only way that these jobs may be accurately proofed is through the use of DuPont's Cromalin proofing system. Not even the Kodak Approval, which displays halftone dot patterns similar to those found in the offset lithographic printing process, simulates spot colors better than the actual printing process. In the future, it is possible that digital proofing devices will adopt a technology which allows them to accurately display spot colors and duotones.

Proofing Processes Which Lack Accurate Simulated Spot Colors

To some degree, all printing and proofing devices lack the ability to display accurate spot colors. However, it is important to note which ones will have the tendency to display spot colors better then others. The printing and proofing processes which display spots colors most accurately are those with the widest color gamuts and most sophisticated color management software. Obviously, color printers with the lowest color gamuts, such as low-end liquid inkjets and thermal wax printers are those which have the least ability to accurately simulate spot colors. Those output devices which most accurately display spot colors include dye sublimation, continuous inkjet and dye ablation digital proofers.

Chapter Four

Substrates and Digital Output

Chapter 4: Substrates and Digital Output

Printing and Proofing Processes for Various Substrates

Proofing Processes Which Allow For a Variety of Substrates

One of the major advantages that many proofing technologies share is their ability to create output on several different substrates. Many color printers and proofers print on substrates which range from the smoothest laser paper to recycled papers of various surface textures, to artist's canvas. Often, low and mid-range color printers and preproofers may display different imagery characteristics on different substrates, but for the purposes that they fulfill (design comps with *pleasing color*), these characteristic variances are acceptable. Examples of some changing imagery characteristics from substrate to substrate include changes in color hue and saturation, image sharpness, and densities of the actual printing colorant (wax, toner, ink). In contrast to those using low and mid-range output devices, the users of high-end preproofers and proofers are often able to compensate for changes in color hues and saturation by way of color correction programs which enable them to adjust these color characteristics.

The printing and proofing processes which are able to provide output on a wide range of substrates include phase-change inkjet, large format liquid inkjet, color laser, continuous inkjet and dye ablation.

Phase-change inkjet printers provide output on extremely smooth paper surfaces such as those with gloss coatings, or on rough surfaces such as those found on a variety of recycled papers. With the phase-change process, liquid ink droplets propelled towards the substrate solidify upon contact and cooling. This means that the inks used are barely absorbed by the surface of the substrate. After attached to the substrate by slight absorption and cooling, the solidified droplets are then cold fused to the substrate by rolling the page between two rollers to improve the overall surface texture of the print. Note that the small amount of color shifting or change is usually acceptable due to the fact that phase-change printers are usually not required to produce contract viable output.

By using inks which are only slightly absorbed by the substrate, the phase-change process is not vulnerable to large amounts of ink spread when printing on highly porous substrates such as recycled papers. The term *ink spread* refers to how much bigger an imaged halftone dot becomes when it is absorbed by the substrate. Ideally, an ink droplet should be completely absorbed almost instantaneously (Pierce 1995). The faster a droplet is completely absorbed by a substrate, the less tendency it has to spread. Unfortunately, porous substrates soak in inks slower and to a greater extent, so that the original ink droplet grows in size as it is diffused into the page. If an ink droplet is severely soaked into the substrate, it looses its shape and definition. From afar, a halftone pattern which has suffered from large amounts of ink spread displays muddy colors (due to over-sized, improperly overlapping dots which grew during absorption) and blurred images (due to the loss of dot definition or shape during absorption).

As mentioned earlier, the phase-change inkjet process will also print on glossy surfaces such as transparencies and gloss coated papers. Again, the small amount of ink absorbed into the substrate and the cold fusing of the ink onto the substrate, does not damage the coating on glossy papers or transparencies. Processes which use heat to fuse toner onto a page, such as color laser copiers and printers often have a degrading (melting) effect on these coatings or require a special transparency material.

LARGE FORMAT INKJET

Some large format liquid inkjet printers also have the ability to print on various substrates. Although these substrates may be created by the manufacturer of the output device, large format liquid inkjets can print on uncoated and light weight recycled stocks, as well as semi gloss and full gloss substrates. As one of the purposes of large format liquid inkjets lies in the creation of signs and posters, many of them print on polypropylene plastic films which may be clear, partially opaque (for backlit presentations), or completely opaque. It is even possible (depending the printer), with the reasonably sophisticated color correction systems present with large format liquid inkjets, to print on alternative substrates such as finely knit and coated artist's canvas.

The reason behind the manufacturers of large format liquid inkjets creating special substrates for their output devices is due to the liquid inkjet process. This process simply sprays dots of liquid ink onto a substrate in a finely controlled manner. As the liquid ink droplets come into contact with the substrate, they are absorbed and dry in what is usually a short amount of time (1-2 minutes). Unlike the small amount of absorbancy of ink into the substrate related to the phase-change process, a higher absorbancy and spread factor is present in liquid inkjets. With this higher factor, substrates must be specially formulated to deter excess absorbancy, lest the intended dots of ink turn into "splotches" rather than dots. Although high gloss coatings naturally prevent great amounts of ink absorbancy, uncoated stocks may lead to an improper (excess) amount of ink spread. Any uncoated stocks made by the manufacturer for use with their specific large format printer contain short paper fibers. Shorter paper fibers create a sheet with higher density. The greater the density of fibers in a sheet of paper, the less they tend to absorb ink and cause it to spread undesirably. Less absorption means a smaller amount of time for that absorption to take place. This results in a smaller factor of ink spread. As mentioned earlier, this is due to the fact that the quicker an ink is absorbed into a substrate, the less time it has to spread undesirably.

COLOR LASER

The next printing process which accepts a few different substrates is the color laser process. Color laser printers produce their best output on papers with highly smoothed and uncoated surfaces. As color lasers use heat to fuse toner to the printing substrate, any coatings on glossy papers may melt as toner particles are fused onto the printed page. Additionally, a substrate with a smoother surface enables these toner particles to pile and overlap in a very consistent manner. With the consistent application of toner particles to a substrate, crisper imagery is achieved. Although more porous and rougher surfaced laser-quality recycled papers may be used with some color laser printers, imagery may suffer from the uneven surfaces on these pages. The other substrate upon which a laser printer may print is a specially formulated transparency medium. Transparencies which run through laser printers are created with a high tolerance to the extreme heat used during the process which fuses toner to a printed page.

CONTINUOUS INKJET

Continuous inkjet printers also print on a variety of substrates. This is possible due to the high amount of color control and ink throughput control made available through software to the users of these high-end preproofers or proofers. As with other non-phase change inkjet processes, the continuous inkjet prints best on a specially formulate substrate which absorbs ink droplets quickly and prevents them from spreading. Even though the inks used in these proofers are absorbed into porous and/or recycled substrates to a greater extent than those of a phase-change inkjet, a user may specify (within the limits presented by a specific device) the actual amount of ink sprayed onto the page. Substrates with a greater amount of ink absorbancy and a higher ink spread factor may be printed upon with less total ink throughput to lighten the overall printed image, or more throughput to darken and saturate the image.

Although continuous inkjets can print on coated or glossy papers, an undesired effect may occur. When printing on coated papers, the ink droplets from a continuous inkjet are only slightly absorbed by the substrate. This tends to make them move around a bit before drying. The undesired effect may be a slightly blurred, printed image.

DYE ABLATION

The process used by the Kodak Approval system, dye ablation can also produce output with a variety of substrates. The dye ablation process images process color separations which may be adhered onto the final, desired substrate.The major restriction to this process is an exclusion of thick substrates such as card stocks. Additionally, in the case of the Approval, one may not print on polypropylene films.

PROOFING PROCESSES WHICH REQUIRE SPECIAL SUBSTRATES

The next few printing and proofing processes require the use of special substrates or benefit greatly from them. Two of them require extremely smooth paper or transparency materials and one requires a special image carrier which absorbs vaporous dyes.

THERMAL WAX

At some point in the near future, thermal wax printers may print on a variety of substrates. Presently, they are limited to specially coated, extremely smooth paper produced specifically for the thermal wax process, or to transparencies. Although transparencies printed on thermal wax printers surpass the color depth of those printed on even dye sublimation printers, a thermal wax print on anything but its specially formulated paper displays mottled imagery and graphics. This poor image quality and lack of solid color areas is caused by the small crests and troughs which appear in even the smoothest laser quality papers. Bumps such as these keep the wax droplets in the thermal wax process from adhering to the substrate. However, some thermal wax printers, such as the Tektronix 240 use a substrate primer to smooth the surface of a printed page. This primer is printed directly onto the substrate under all image areas. This enables wax droplets to adhere on slightly rougher papers than the paper mentioned earlier which is specially made for the thermal wax process. Unfortunately, any paper which is even slightly rougher then high quality laser paper, such as typical copier bond, degrades image and graphics qualities greatly.

LIQUID INKJET

Liquid inkjet printers, often the least expensive color output devices, require a coated paper in order to print their highest quality output. This specially coated paper keeps ink droplets sprayed onto it by the liquid inkjet process from spreading after slowly absorbed by the substrate. Inkjet printers may also print on transparency materials, but the amount of ink required to display even mediocre color depth on these materials will deplete inkjet cartridges very quickly and becomes impractical.

DYE SUBLIMATION

The dye sublimation process requires a single type of specially made, proofer model specific substrate. During the dye sublimation process, dyes from transfer rolls are sublimated (turned into a vaporous form by heat), jump across a small gap between transfer roll and substrate, and are then reabsorbed by the substrate. This special substrate is engineered to absorb vaporous forms of dye as quickly as possible. For most dye sublimation proofers, it is manufactured as both a solid white substrate to resemble paper, and a clear substrate which is used as a transparency medium. Those specially made substrates which are meant to resemble paper are often manufactured at different brightnesses of white in order to simulate different brightnesses of white paper. No other substrates may be used with dye sublimation proofers.

SMOOTHNESS

Generally speaking, the surface qualities of all highly recycled papers (containing more then 20% recycled fibers) are much rougher in texture than high quality, bright white laser quality papers. These papers, and many others such as typical low quality copier bond, affect the output of all printers and proofers which accept a variety of substrates. Papers with rough surface qualities tend to cause a blurring of small text and all imagery and graphics. Roughly surfaced papers do not provide a consistently level surface upon which to spray or bond colorants. Colorants printed on rough surfaces tend to display uneven patches of solid color and unrefined gradations. Additionally, the more crests and troughs a paper's surface has, the more difficult it is for the printer or proofer to create properly spaced halftone patterns. Therefore, the sharpness of halftone imagery also suffers from substrates with rough surface qualities

Surface qualities of substrates also affect the printable resolution of imagery and graphics on output devices which accept a variety of substrates. In regards to printable resolution, the most common rule which may be applied to output on substrates with differing surface characteristics is as follows: a smoother substrate surface quality allows for higher printable resolutions, while rougher substrate surface qualities require printing at a lower resolution.

Coatings and Absorbency

How much a paper absorbs colorants which are placed upon its surface may be referred to as paper absorbency. The absorbancy of a paper directly affects which printing and proofing processes it may be used with, how saturated colors appear to be on a printed page, and how sharp printed text, imagery, and graphics are displayed.

In regards to image sharpness, the following characteristics of ink absorption should be considered. Note that a paper's absorption characteristics mostly affect those proofing processes which require their colorant to be absorbed by the substrate (liquid inkjet, phase-change inkjet, continuous inkjet). As mentioned earlier, the absorption of an ink into a substrate should occur quickly in order to reduce the spread of the ink droplet through the substrate which results in blurred halftone or stochastic dots. A paper which greatly absorbs colorants will blur the edges of halftone dots due to a large amount of ink droplet spread. This results in a blurred overall image with muddy colors. An illustration comparing papers with greater and lesser amounts of absorbency and their simulated factors of ink spread may be found below (fig. 59). Note how the paper with a lower amount of absorbancy lets the halftone dot retain overall sharp edges with most of its pigment residing on top of the substrate, while the rest of the ink's solution (which is responsible for adhering an ink to a substrate) has soaked into the page (Tektronix, Simply Brilliant, 1996).

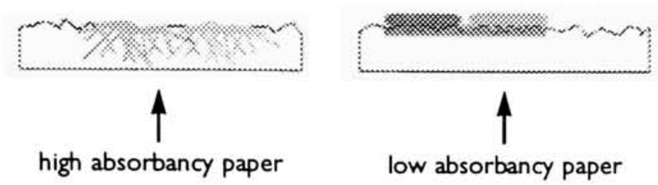


Figure 59

The coating of a substrate directly affects the way any ink appears on its surface. As mentioned earlier, some specially coated papers for use with specific printing or proofing processes lessen ink spread and quicken absorption time. These two variables are responsible for differences of lightness and darkness in the appearance of solid color areas on printed pages. In Figure 60, a single cyan ink has been printed in a solid patch on several substrates. Note the varying lightness and darknesses of the resulting solid color patches printed with the same cyan ink (Field, 86).

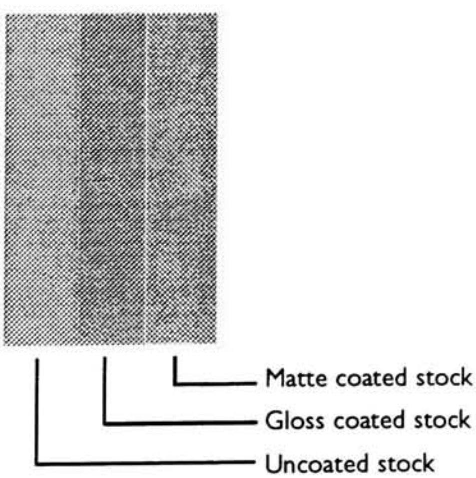


Figure 60

THICKNESS AND FLEXIBILITY OR STIFFNESS OF SUBSTRATES

The thickness and flexibility of a substrate determines its use with different printing and proofing processes. Many printers and proofers will not accept cover weight substrates due to the output process. Certain processes, such as color laser printers and copiers, wrap the utilized substrate around a drum while colorants are applied to it. A substrate which is too thick leads to paper jamming. Additionally, certain colorants, such as toner particles, tend to scrape off of thick or inflexible papers such as cover weight sheets or cardstock.

Printing and Proofing on Colored Paper

COLORED PAPER EFFECTS ON IMAGERY AND GRAPHICS

Printing on color stocks directly influences the color characteristics of printed text, graphics, and imagery. Simply speaking, the color of the substrate is always represents the white of a graphic or photographic image. For example, printing snow-capped mountains on a green paper would result in green snow caps. Obviously, because printing inks are transparent, colored substrates affect all of the other colors in an image as well. For example, a light blue paper will darken and shift the hues of all shades of cyan, magenta, and black found in an image, while creating muddy yellows. These dirty yellows are the result of opposing, or in the artist's terms complimentary colors.

The following diagram (fig. 61) simply illustrates opposing colors. Note that the addition of a color residing near a point on the triangle to that color directly opposite of it which resides on an opposing side of the triangle will dirty either color due to their "complimentary" properties.

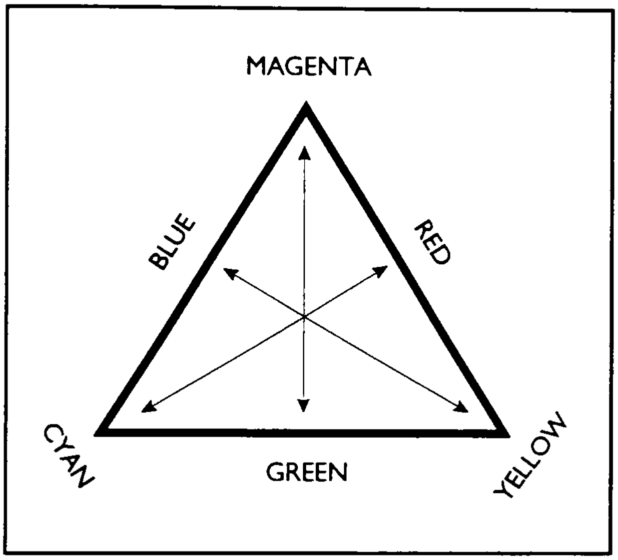


Figure 61

Colored Paper Effects on Screened and Process Colored Text

Just as colored paper will affect imagery, so does it affect solid-colored and screened text. Solid-colored text and display type will suffer the same dirtying problems as solid color patches in graphics and imagery do. As complimentary (opposing) colors appear through the transparent printing inks, colored text becomes dirty if the substrate is of an opposing color, or shifts hue and lightness or darkness if the substrate is a differing, yet not opposing color. Screened text suffers in the same manners, but to an even greater extent. As screened text is lighter in appearance, any colored substrate behind it will affect its hue, saturation, and tone to a greater extent than those same characteristics of solid colored text.

Environmental Effects on Substrates

Just as environmental characteristics such as temperature and humidity affect substrates used for printing on the press, so do they affect substrates used for digital output devices. All of the following environmental effects are only influential in regards to paper substrates. Plastic based substrates such as those used for dye sublimation proofing, or transparency mediums are not effected by moderate changes in humidity and temperature.

The two most influential environmental factors which affect paper substrates are temperature and humidity. All papers have a certain percentage of moisture content. As a paper absorbs water vapor from the air, it is said to have an increasing amount of this content. A paper with an increasing amount of moisture content expands in all directions. Note that paper increases several times more in the dimension which is parallel to its grain direction, than the dimension which is perpendicular to its grain direction. Paper which has expanded in size tends to jam more sensitive printer and proofer substrate feeding mechanisms.

Aside from humidity, the temperature of an environment also affects paper substrates. Constant high temperatures will rid paper of its moisture content. Most paper with little or no moisture content is brittle and/or delicate. Dried, brittle paper tends to promote the ink spread factor present in digital output processes such as liquid inkjet and continuous inkjet.

On the contrary to the affects of high temperatures, constant lower temperatures with controlled relative humidities prolong the life of all papers and therefore create the ideal storage conditions for all paper substrates used with digital printers and proofers.

Printing and Proofing Process Supplement

How the Printing and Proofing

Processes Work

Printing and Proofing Process Supplement

How the Printers and Proofers Work

Each printing and proofing technology brings with it its own qualities, materials, and imaging process. To better orient the reader with the current, most widely used digital color output technologies, this supplement contains a simple explanation of how each one operates. In addition to operational explanations, each section notes some of the general advantages and disadvantages of each technology. The printing and proofing technologies which are explained here include liquid inkjet, phase-change inkjet, thermal wax, color laser, dye sublimation, continuous inkjet, and dye ablation.

LIQUID INKJET

The liquid inkjet process in its least expensive form (most do not surpass the cost of $2000) is a fairly simple process to explain. As shown in the diagram below (fig. 62), droplets of liquid ink are propelled by the printhead towards the substrate in a precisely controlled manner. Unlike the phase-change inkjet process where the ink droplets resolidify almost instantaneously as they cool on the substrate's surface, the output of liquid inkjet printers must be allowed to dry after being applied to the printed sheet. These droplets of the four process colors are placed by the *printer engine* on the substrate in halftone patterns which have been custom engineered to display the best imagery characteristics in accordance with device specific resolution and output quality. Vector based graphics and solid text are also imaged with unique halftone patterns or solid ink areas respectively. A simple diagram of the liquid inkjet process may be found in Figure 62. Note that the printhead travels across the paper's short axis while dispensing ink. Resolution of the output with regards to the vertical movement of the printhead is determined by the increments at which the printer advances the paper forward on the drum. Output resolution across the paper is directly related to how small of a halftone dot the printhead can create as it moves across the paper.

The major advantage of all liquid inkjet proofers is their low cost-per-print. Unfortunately, the resolution, color accuracy, and overall image fidelity of liquid inkjet output is suitable for only the roughest design compositions. Additionally, the liquid inkjet process requires special coated paper if the resulting output is to display bright colors. Otherwise, the liquid ink inherent to the process sinks into the paper and shows only dull to partially saturated colors and imagery (Tektronix, Bright Ideas, 1996).

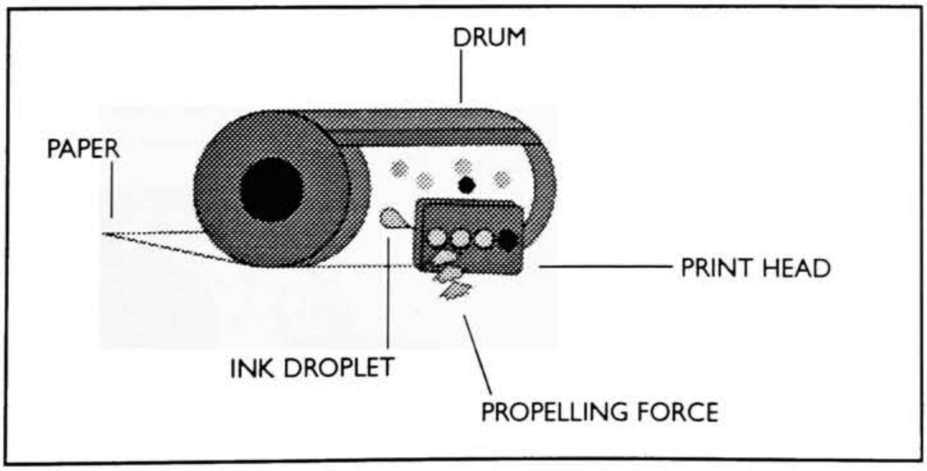


Figure 62

PHASE-CHANGE INKJET

In regards to printing process complexity, phase-change inkjet printers are a step above the liquid inkjet printing process. Instead of using stored liquid ink which is propelled in the form of droplets onto the paper, the phase-change process begins with solid ink sticks. The "phase changes" in phase-change inkjet printers occur with the colorants (inks) used for printing. When operational, the printer melts sticks of solidified ink into a reservoir leading to the print head. This melting process is considered the first phase change of the colorant. As the printhead moves across the substrate (similarly to the liquid inkjet process), the heated liquid ink is propelled in droplet form towards the substrate. Practically the instant that the ink hits the substrate and cools, it returns to its solid state. This change from heated liquid to cooled solid is the second phase change of the colorant. After several passes of the printhead, the substrate is pressed in between two rollers to cold fuse the solid ink droplets onto the printed page. The cold fusing step of the phase-change inkjet process promotes a smoother overall feel to the final print. Figure 63 illustrates a brief explanation of phase-change technology (Tektronix, Bright Ideas, 1996).

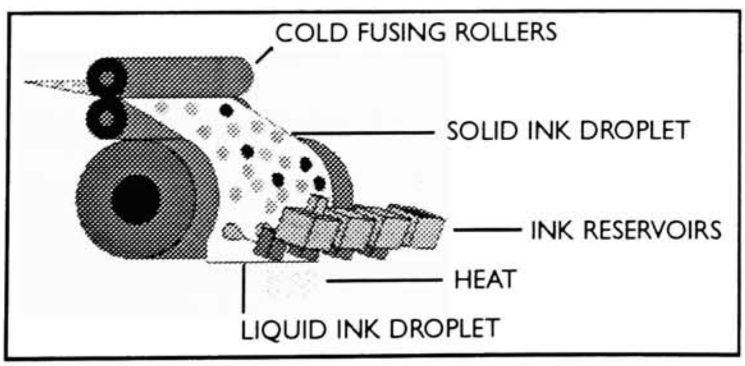


Figure 63

The major advantage of the phase-change process is its ability to print on many different substrates with varying surface smoothnesses. This is possible due to the extremely fast cooling and solidification of the liquid inks placed on the surface of the substrate. Unfortunately, printers that use phase-change technology are limited to lower resolutions (usually under 600 dpi) and lack the color accuracy desired by most users for any applications more important than design compositions.

Thermal Wax Transfer

Unlike any inkjet printer, the thermal wax printer uses a transfer roll of colored wax. The transfer roll is divided up into page sized sections. Each section is colored with wax in the hues of the process colors cyan, magenta, yellow, and black. As one process colored section is moved across the thermal printhead, the wax from that part of the transfer roll is melted and adheres to the substrate. The wax which is melted is liquefied by thousands of individually controlled heating elements on the printhead. Each element melts a pinpoint spot of colored wax onto the substrate. This melting process is repeated four times, once for each of the process colors. Figure 64 shows a simple diagram explaining the thermal wax transfer process. Notice the consecutive, process colored sections of the the transfer roll material.

The major advantages of the thermal wax process lie in its printing speed, and its solid, saturated colors. Although these are only pleasing colors, not accurate ones, the thermal wax process does an excellent job of transferring them to transparency material. Due to this fact, thermal transfer printers are excellent for business presentations which require overheads with graphics and brightly colored text. Unfortunately, the thermal wax process requires extremely smooth paper for proper wax adhesion. Besides printing on specially made, smooth paper, many thermal wax printers place a clear coating on rougher substrates before applying colors. This coating aides thermal wax printers to print on a few additional, rougher papers, but not a wide variety of recycled or lower grade papers (Tektronix, Bright Ideas, 1996).

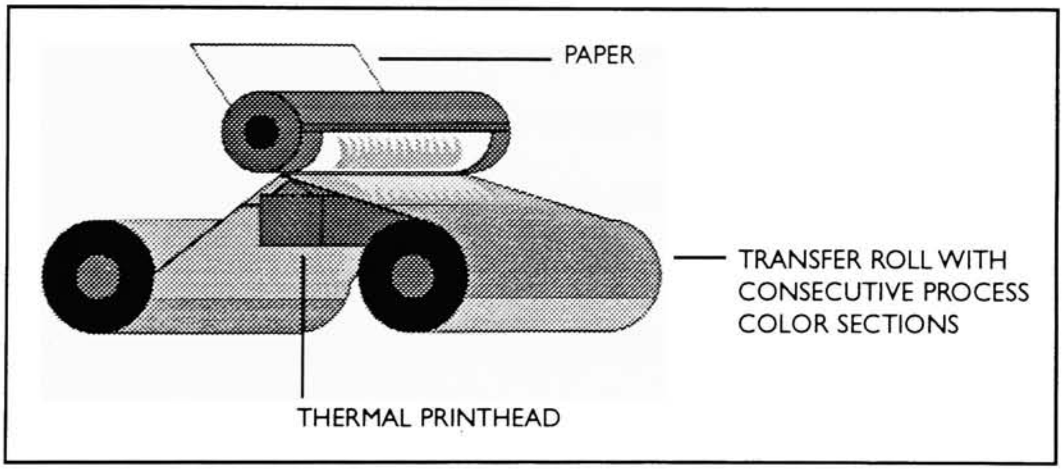


Figure 64

Color Laser

In the past two years, color laser printing technology has moved the fastest and farthest from its predecessors. Newer color laser printers have better registration, higher resolutions and finer toner. In addition to their speedy technological progress has come higher quality color and detail as well as a greater degree of printer complexity. A color laser printer works in much the same way that a color laser copier does. The color laser process first involves a photoreceptive drum or belt which is struck by a laser four times. Each time the laser strikes the photoreceptive drum (or belt), it exposes the non-image areas (the negative space) around a set of halftone patterns and text for one of the process colors. Toner, in one of the process color hues, is then applied to the drum. Note that the negative image areas which were exposed by the laser do not attract toner. The positive areas which have attracted toner then electrostatically transfer that toner to the substrate. After the transfer, the toner is pressed onto the substrate by rollers which may or may not be heated (Tektronix, Bright Ideas). In more advanced, newer color laser printers, all four patterns of toner are transferred to the paper at once (which is then pressed in between heated or non-heated rollers) (Heid 1995, 124). Older models transfer toner one color at a time. The advantage to the newer technology appears in the form of better registration of the four process colors. Figure 65 shows four transfer (older) color laser technology, while Figure 66 shows the newer type of color laser technology.

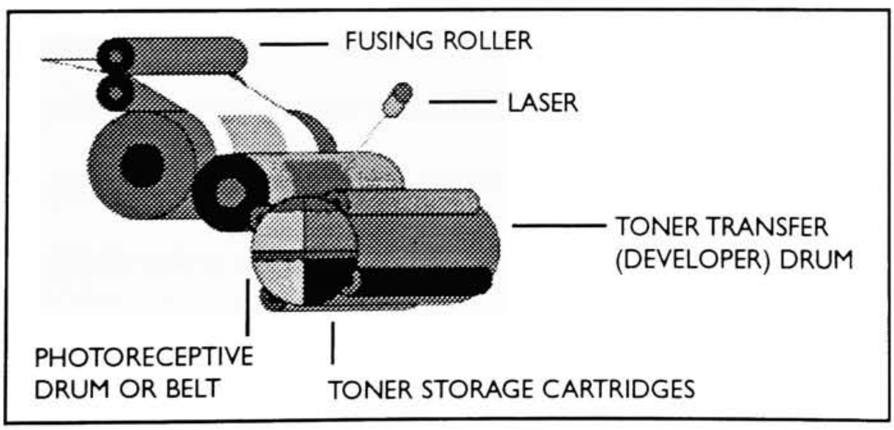


Figure 65 (old technology)

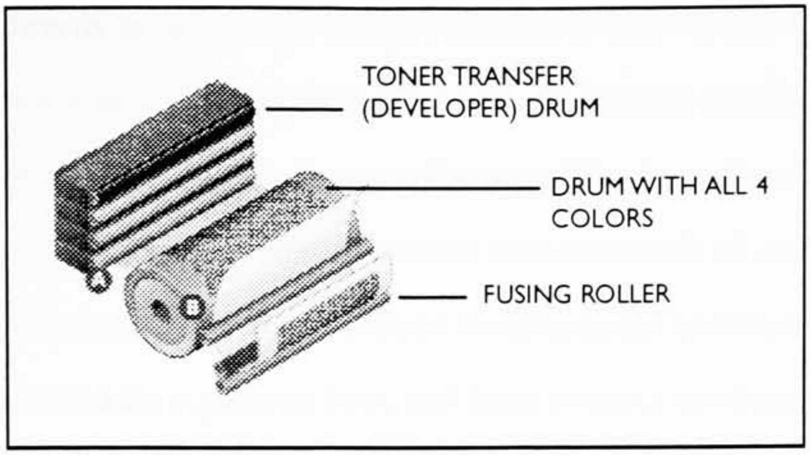


Figure 66 (new technology)

The major advantages of color laser technology are its higher printing resolution (currently up to 1200 dpi), its use of new screening processes such as stochastic screening, its high speed, and its ability to print on a variety of substrates. Although the color quality of laser prints is still only considered to be so called pleasing color, the ability of many color lasers to produce near continuous tone imagery with stochastic screening makes their output worthy of displaying high grade, photographic design compositions.

Dye Sublimation

Unlike all of the printers mentioned so far, dye sublimation output devices are most often referred to as proofers. This is due to their ability to produce more accurate colors and higher quality continuous tone imagery.

The dye sublimation process involves the sublimation of dyes off of a transfer roll. Sublimation is defined as the conversion of a material from its solid state, directly to its gaseous state—without ever turning into a liquid in between these two states. The transfer roll in a dye sublimation proofer is divided into process color, page sized sections just like that of the thermal wax printer. During the output process, a thermal printhead with thousands of individually controlled elements heats miniature points of the dyes on the transfer roll. The heated dyes sublimate into a gaseous form and jump across a small gap towards the substrate. This substrate, which is specially made substrate for dye sublimation proofers, is engineered to absorb even the tiniest amount of gaseous dye. As the pinpoints of dye are absorbed by the substrate, they produce halftone dots with slightly undefined edges. These "blurry" halftone dots blend into each other and simulate a continuous tone image. Figure 67 shows a diagram of the dye sublimation process.

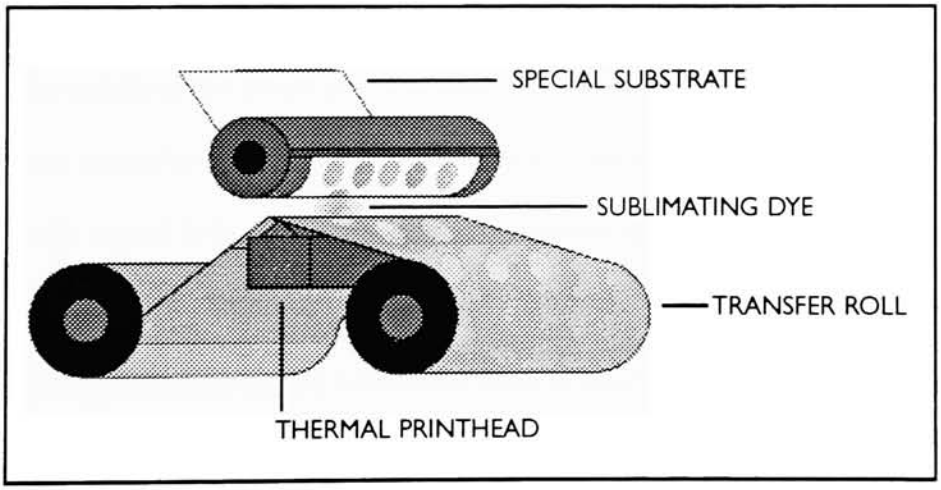


Figure 67

The major advantages of dye sublimation proofers is their ability to create near photographic quality imagery (with continuous tone). They are also able to display the a color gamut similar to that which is found in most commercial printing. Unfortunately, the continuous tone dye sublimation process proves to be a poor renderer of typography. In addition to small typographic elements suffering directly from the dye sublimation process, for even shapes rendered with vectors (created by Adobe PostScript) suffer from blurred edges, text also suffers from the low resolution of dye sublimation proofs. Most dye sublimation proofs are printed at 300 dpi. As mentioned in *Chapter 2: Proofing Typography*, such a low resolution on any printer degrades the smooth edges and fine serifs found on all letterforms (Tektronix, Bright Ideas).

Continuous Inkjet

The continuous inkjet process may vary from device to device. The following section describes the continuous inkjet process found in Scitex IRIS proofers. Just as with liquid inkjet printers, the continuous inkjet proofer uses liquid inks. In the IRIS continuous tone process, four streams of process colored ink are propelled through the printhead which consists of four separate nozels (one each for C M Y K). As the ink leaves the nozzles, it breaks into a continuous stream of microscopic ink droplets which measure 15 microns in size—about the size of a red blood cell. The droplets of the four process colors pass through a charged tunnel toward the substrate. Uncharged droplets become those which reach the paper to create imagery. Positively charged droplets are deflected into a waste container. Each droplet of the leftover stream of uncharged droplets is precisely sized and placed by the IRIS proofing engine. The engine has the capability of placing up to 31 droplets of each process colored ink into the area of a single pixel (picture element). In turn, these miniature pixels create a continuous tone image which appears to be printed at 1500 to 1800 dots per inch. However this measurement is derived from counting all of the droplets of each process color placed on the substrate by the printer's engine. When each dot is measured as a *combination* of the four process colored ink droplets, the user obtainable resolution becomes 200, 240, or 300 dpi (IRIS, 1996).

Unlike the larger droplets of liquid inkjet printers, the small droplets and specially formulated inks of the IRIS continuous inkjet proofer are well suited to print on a wide variety of substrates. Other advantages of the continuous inkjet include a color gamut which exceeds that of commercial printing, unmatched continuos tone imagery and gradations, and a high degree of print-to-print repeatability. The disadvantages of the IRIS proofing system lies in its display of typography. Again, all typographic elements suffer from the low resolution of 300dpi. A diagram of the IRIS continuous tone process is displayed in Figure 68.

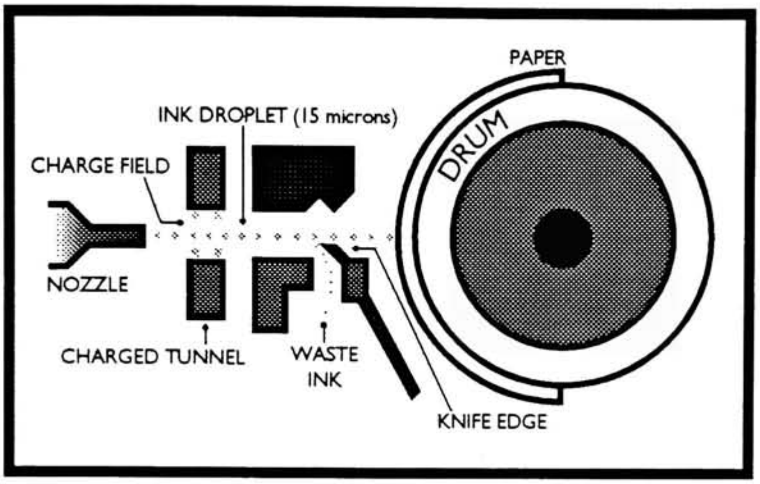


Figure 68

Dye Ablation

The most sophisticated color management and imaging technology, dye ablation, is found within Kodak's Approval proofing engine. With this technology, the dye ablation process actually mimics the halftone dots and their patterns which are common to the offset lithographic printing process. The first step in the dye ablation process of the Approval system loads a receiving base substrate onto a rotating drum. The precise placement and adhesion to the drum are aided by a vacuum system. Then, one by one, process colored donor materials are placed in contact with the base substrate. Each time this occurs, a thermal laser images halftone dots and line images (corresponding to the specific process color) onto the the base. After all of the donors have been contacted and left the base substrate, the final proof may be observed (Kodak, 1996).

The major advantages of Kodak's dye ablation proofing process lie in its ability to display extremely accurate and repeatable colors, create high resolution proofs printed at resolutions of upto 1800 dpi, output proofs on a wide variety of substrates, and display halftone dot patterns which mimic those of the offset lithographic printing process. Figure 69 is a simple diagram of the Kodak Approval system's dye ablation process.

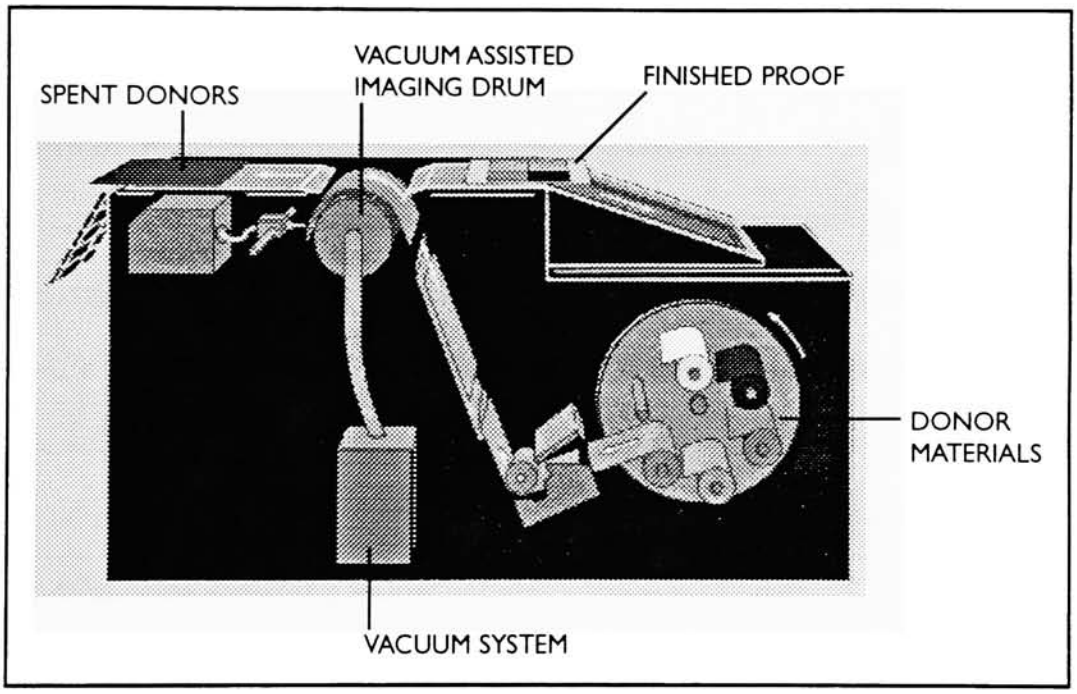


Figure 69

An Brief Explanation of Halftone Screening and Stochastic Screening

HALFTONE SCREENING VS. STOCHASTIC SCREENING

All digital color output devices use one of the following screening technologies: halftone, fixed dot stochastic, or variable dot stochastic. Most all of those which use halftone screening print dot patterns which are specifically designed to maximize the quality of a printer or proofer's output depending on the process and resolution of the output device at hand. The exceptions to this rule are the Optronics Intelliproof which uses the same raster image processor and halftone patterns for both films and proof, and the Kodak Approval system which images halftone patterns mimicking those of the offset lithographic printing process. Generally speaking, the individual halftone dots used by all halftone-based printers and proofers are larger than the stochastic dots displayed by those output devices using this newer type of screening technology. Thus, (with the exception of dye sublimation proofers which use halftone screening) output devices using stochastic screening are able to produce near continuous tone quality imagery, while halftone-based output still displays larger, more noticeable dot patterning. Additionally, the stochastic process's smaller dots promote finer detail at a lower resolution, and do not display moiré patterns. A brief explanation of stochastic and halftone screening follows.

All halftone screening technology is based on a grid of pixels. Each grid block represents a pixel. Groups of pixels form halftone dots. A 100% black or solid color halftone dot may be thought of as a group of pixels which fills an entire square on a grid. These squares vary in size depending upon the software used to create them. For the sake of explanation, one may imagine that a square measures 10 x 10 pixels. Therefore an 80% halftone dot is filled with 80 pixels. Halftone dots of varying sizes are aligned on these grids to display differing shades of grey or color. Note that the spacing between these dots is equal, due to the consecutive placement of 10 x 10 pixel squares on the grid (fig. 70).

With stochastic screening technology, the spacing between the above square is no longer made to be equal. Instead, a single dot size is chosen (always much smaller in size when contrasted to a halftone dot) and the spacing between dots is varied randomly. This type of stochastic screening is called Fixed Dot Stochastic Screening. When the dot sizes of this type of stochastic screening *also* become randomly chosen, the screening process is called Variable Dot Stochastic Screening. Figure 70 illustrates the placement of dots and pixels in grid like (halftone), or random (stochastic) patterns, and also shows the difference in sizes between halftone dots and stochastic dots.

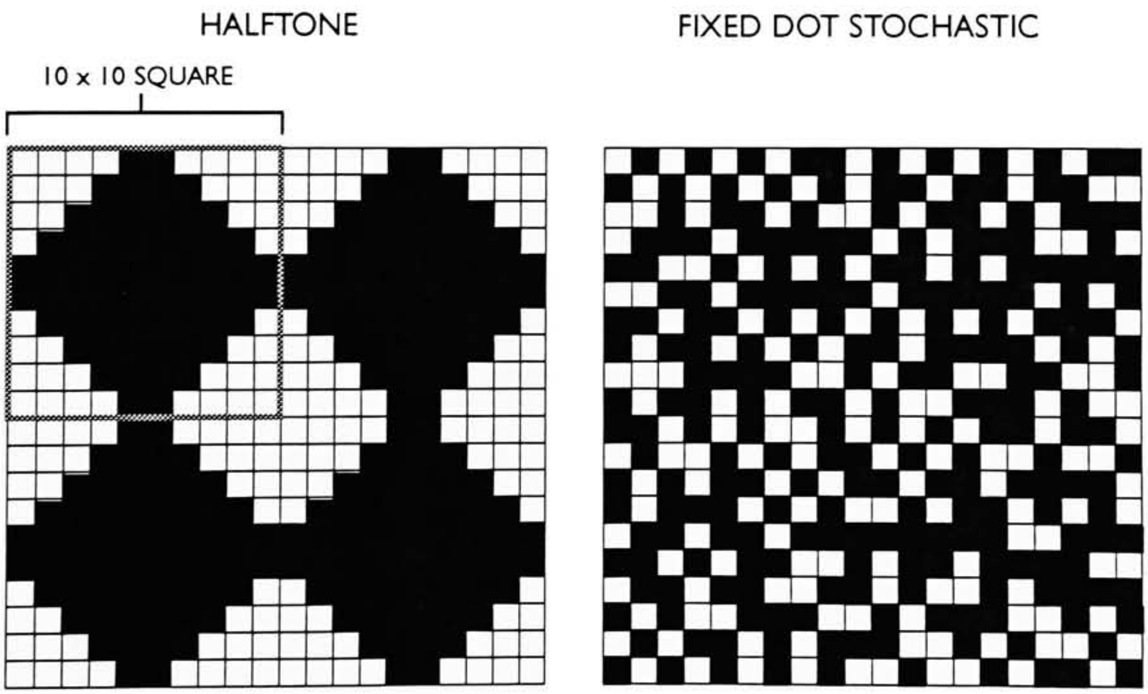


Figure 70

Figure 71 displays the various ways that dots may be placed in both halftone and both stochastic screening processes. Disregard dot size relations between the differing patterns present in Figure 71. The diagram shows dot placement variances only. Also note that the example labeled "flat tint" refers to a shade of color or grey which has been recreated using halftone screening (Fenton 1994, 17).

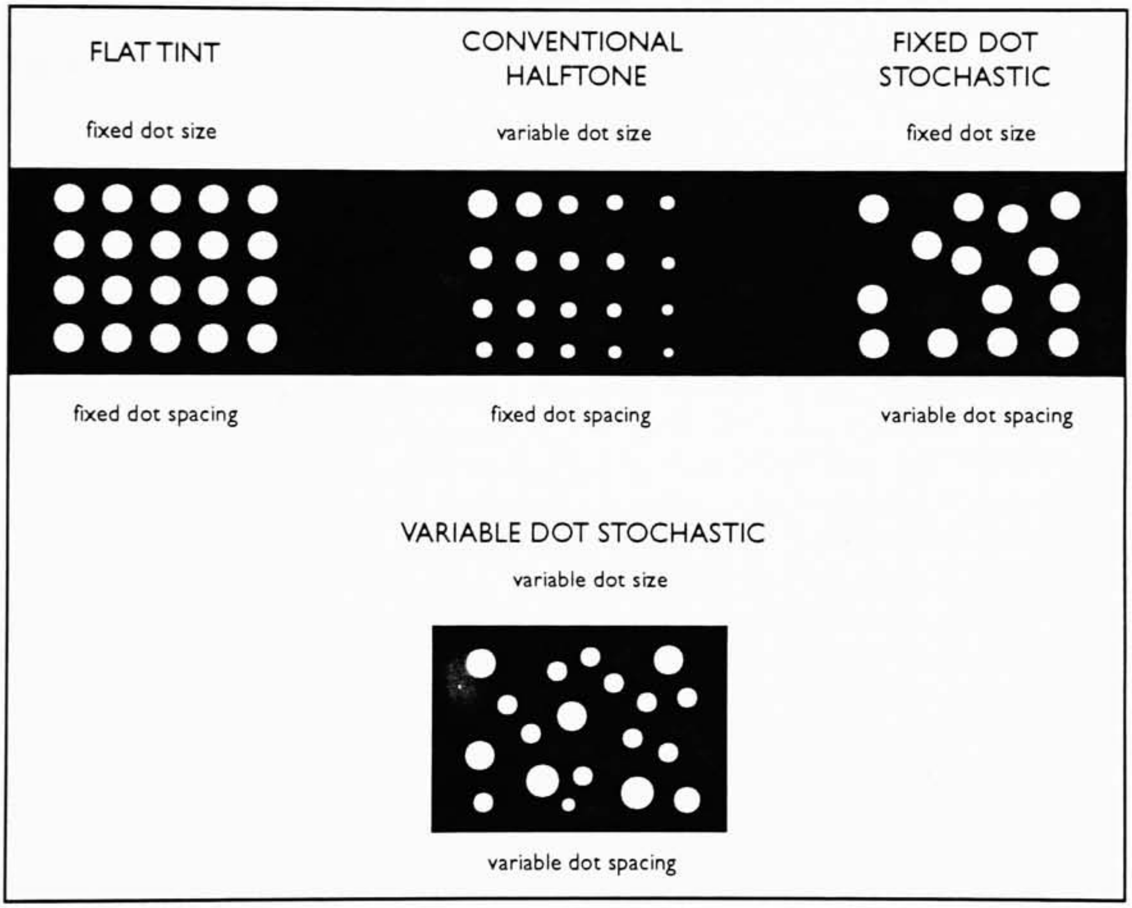
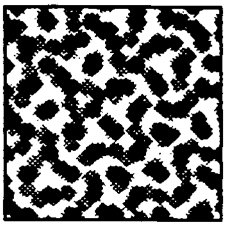


Figure 71

Actual examples of printed pieces using both halftone and stochastic screening technologies may be found below in Figure 72.


conventional

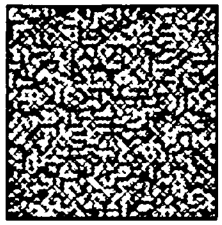

stochastic

Figure 72

Chapter 5: Image Fidelity

Image Characteristics of the Printing and Proofing Processes

Just as it is important for the designer to note how each printing and proofing process affects typographic elements, it is also important to note how each process affects graphics and photographic imagery. As mentioned in the process supplement, each printer and output process creates imagery and graphics with its own halftone patterning or stochastic patterning. Line imagery (vector graphics) is also treated differently by each of the output processes even though it may all be originally created by PostScript. The purpose of this chapter is to orient the reader with the color accuracy and image fidelity qualities related to the most popular printing and proofing processes: liquid inkjet, phase-change inkjet, thermal wax, large format inkjet, color laser, dye sublimation, continuous inkjet, and dye ablation.

LIQUID INKJET

Liquid inkjet printers reside amongst the entry level of color printing. Although they may currently print at higher resolutions than many other color output devices (as high as 720 dpi), they still only display rough renditions of graphics and imagery. The following sample (fig. 73) was printed on a Tektronix Phaser 140 liquid inkjet printer at 360 dpi. The graph in the sample was originally created using a vector based drawing program such as Adobe Illustrator. Notice the roughly shaped image dots and undefined edges of all lines and text. Even at 360 dpi, this print suffers from excess, loosely controlled liquid ink droplets sprayed through the printhead, and the bleeding of those droplets when they hit the substrate. Although these rough details are not as apparent in the overview of Figure 74, clearly visible halftone patterning and only slightly sharper edges are still obvious to the viewer.

Figure 73

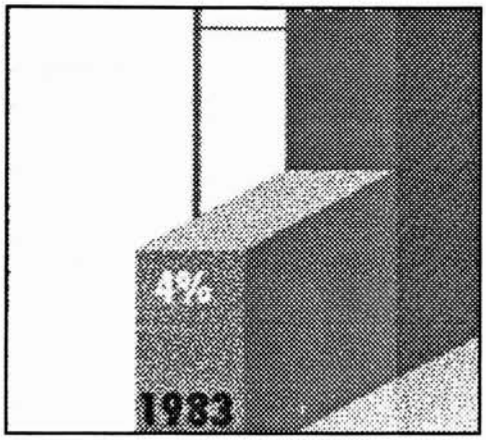


Figure 74

The next two samples, Figures 75 and 76, are from the same printer. These samples display how the liquid inkjet process can affect photographic imagery. Notice that a form of stochastic screening has been used for rendering the imagery. Additionally, note the loss of sharpness and small details (especially in the shadows) throughout the picture. This is due to both the large sizes of the image dots, and their rough edges.

Figure 75

Figure 76

PHASE-CHANGE INKJET

Although phase-change inkjet printers have the advantage over liquid inkjets of being able to print on several different substrates, they still suffer from a lack of sharply rendered image dots. In the samples of the bar graph found below (figs. 77 and 78) notice the slightly sharper edges of lines and shapes. In comparison to the less defined edges found in the previous section's liquid inkjet samples, these graphics benefit from the phase-change process when the heated liquid ink cools and resolidifies as it contacts the substrate. These solidified ink droplets do not bleed nearly as much as the liquid ones used in the liquid inkjet process. Unfortunately, this 300 dpi phase-change inkjet print from a Tektronix Phaser 300i still suffers from a low printing resolution which displays large image dots. And, just as with the liquid inkjet output from the previous section, the colors displayed are merely pleasing colors, not accurate ones.

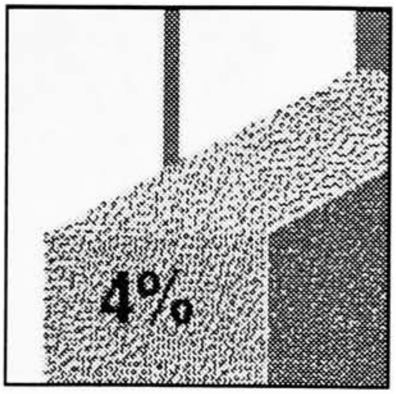


Figure 77

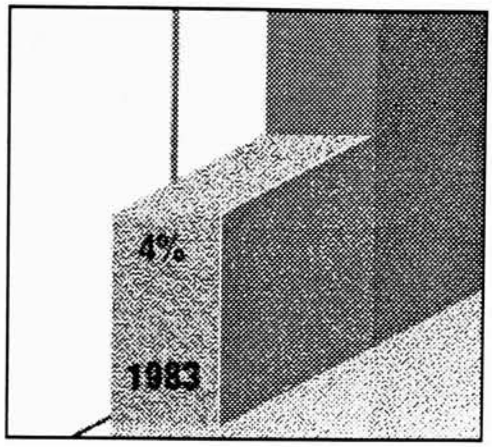


Figure 78

The next two samples (figs. 79 and 80) show the same photographic imagery as displayed in the previous section by the liquid inkjet printer. These too have been printed by the 300i at 300dpi. Notice that although the colors are saturated and the image dots are more defined then the liquid inkjet's, small details are still lost throughout the imagery due to the actual size of the dots. This is especially true in the darker image areas. Also, one should begin to note the lack of any *unsaturated* colors. Just as with many other low-end color printing processes such as entry level liquid inkjet (not continous inkjet) and thermal wax transfer, a lack of unsaturated colors is the printing process's inability to display a certain color gamut. The color gamut of the phase-change inkjet process as well as those of the low-end liquid inkjet and thermal wax transfer processes are much smaller than that of the commercial printing process. This is the reason why many pastels are often shifted to much more saturated hues of the desired color. This lack of color gamut is apparent in magnified view of the sky in Figure 79.

Figure 79

Figure 80

THERMAL WAX TRANSFER

Although thermal wax printers print on a very limited range of substrates (only specially coated papers, extremely smooth laser stock, and transparencies), they do benefit from their ability to create much sharper halftone dots. With sharper halftone dots and more distinct halftone patterns, the bar graph below in Figures 81 and 82 (printed on a Tektronix Phaser 240) benefits with more cleanly edged shapes and linework than those output by the liquid or phase-change inkjet printers from the previous sections. It is important to note that these benefits are available when printing at the same resolution of 300 dpi. Also notice the bright, saturated colors produced by the thermal wax transfer process which are ideally suited for transparencies.

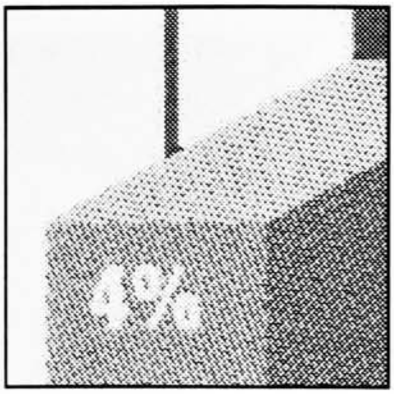


Figure 81

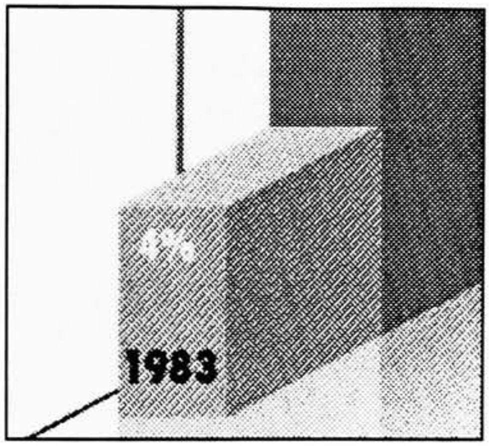


Figure 82

The next two samples (figs. 83 and 84) are of the same photographic imagery in the former sections. As previously mentioned, thermal wax printers have a smaller color gamut than many other output devices and the commercial printing process. This lack of color gamut can be seen in Figure 83 by observing the blue dots which represent the sky in the background. Although these dots are supposed to be representing a very light blue sky, they are barely a pastel blue. Rather, the lightness of the sky is achieved by lessening the amount of halftone dots and leaving greater amounts of white space in between them. This gives the illusion of a light colored, blue sky in Figure 84. On the contrary to a smaller color gamut, the thermal wax process does display gains in the rendition of small details in both the lightest and darkest areas of the photograph. Again, this is due to the sharper and more precisely placed halftone dots made available with the thermal wax process.

Figure 83

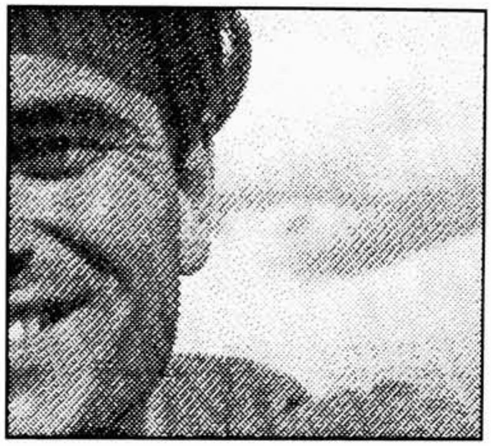


Figure 84

LARGE FORMAT LIQUID INKJET

While observing the following samples, one must keep in mind that output from large format liquid inkjet printers is meant to be viewed from a distance of at least 2 to 3 feet. The following two samples (figs. 85 and 86) were printed on a LaserMaster Displaymaker Professional at 75 dpi using stochastic screening. Figure 85 shows an unrefined image with randomly placed stochastic dots. Although this magnified view displays a rough dot pattern similar to those of the previous liquid inkjet prints, notice that the actual color gamut of the overview in Figure 86 is much broader than the gamuts available with entry level and low-end inkjet printers. The larger color gamut is apparent in the smoother gradations of all colors. This is mainly due to the more advanced imaging hardware and software available with all large format liquid inkjets.

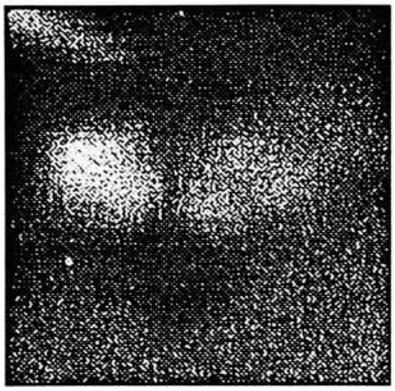


Figure 85

Figure 86

COLOR LASER WITH HALFTONE SCREENING

Color laser printers use a variety of different screening technologies. In the second chapter of this guidebook, one sees that these screening technologies have no effect on solid color PostScript lettering. However, as mentioned, they do have an effect on screened type, and of course graphics and imagery. The first set of samples representing the output of color laser printers was printed on a Tektronix Phaser 550 at 1200 x 600 dpi. These samples use the printer's customized halftone screening patterns. At such a high resolution, the pie chart in Figures 87 and 88 displays crisp linework and smoother overall shading due to the fine screening pattern.

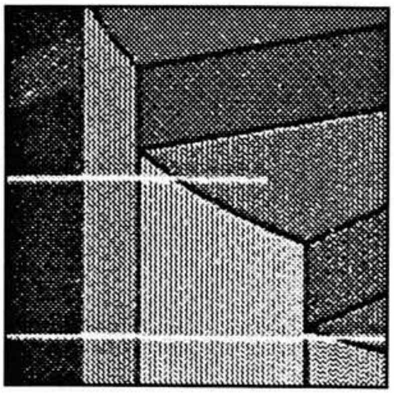


Figure 87

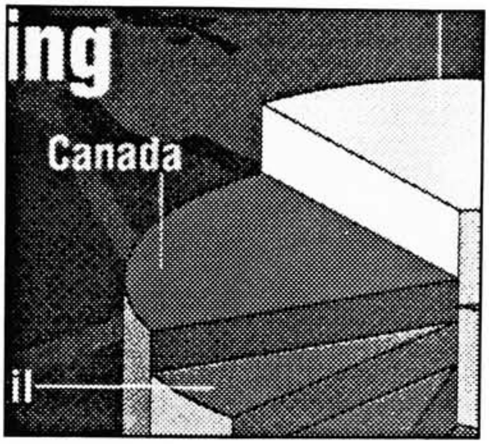


Figure 88

In comparison to those graphics printed with the processes seen earlier in this chapter, the photographic imagery displayed in Figures 89 and 90 also displays added detail. This detail may be seen in both the darker and lighter areas of the locomotive. Notice the colors in the lightest highlights. In processes such as liquid inkjet and thermal wax, a drastic loss of highlight detail and coloring occurs. With added resolution and finer halftone screens, the color laser process manages to display lighter screened colors. The ability to display detailed highlights prevents imagery from appearing washed out. Meanwhile, higher detail and the ability to render a greater number of tonal shades in the dark areas of an image prevents the plugging of shadows.

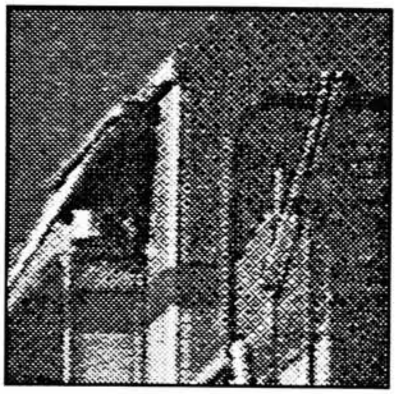


Figure 89

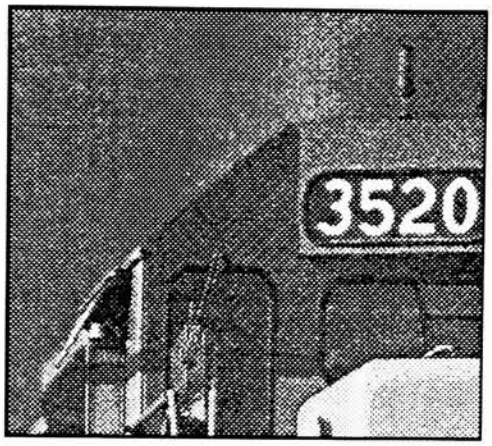


Figure 90

COLOR LASER WITH FIXED-DOT STOCHASTIC SCREENING

As mentioned in the process supplement, color laser printers also use the two different types of stochastic screening technology. The following samples were printed on a QMS Magicolor CX color laser with fixed-dot stochastic screening at 600 dpi. In fixed dot stochastic screening, all image dots are the same size. The samples in Figures 91 and 92 contain solid color vector based graphics and text (created by PostScript). No screening is apparent. However, these two samples do display a printed graphic with uneven shades of red which should be a solid color. These uneven shades are directly caused by two variables in the color laser process. The first variable relates to the transfer of toner from the toner cartridge onto the photoreceptive drum (or belt). If this transfer applies toner particles to the photoreceptive drum unevenly, then variations in solid color patches on the final output may occur. The second variable relates to the substrate used for printing. If the substrate is mediocre, copier grade paper (non-laser quality) it may not have a smooth enough surface for optimum performance of the laser process. Although color lasers can print on such lower grade papers, an unrefined substrate may not allow the toner of the process to bond evenly to it. An uneven bonding of the toner to the substrate also results in variations in solid color patches on the print. Note that these two variables affect all color laser printers no matter which screening processes they use.

Figure 91

Figure 92

The following samples (figs. 93 and 94) were printed on the same QMS laser with fixed-dot stochastic screening. Notice that although the space between dots varies, all dots are approximately the same size. One may also observe that the magnified view (fig. 93) appears somewhat similar to the output representing photographic imagery from the low-end liquid inkjet printer at the beginning of the chapter. However, unlike an entry level liquid inkjet's output, the color laser output displays a larger color gamut.

Figure 93

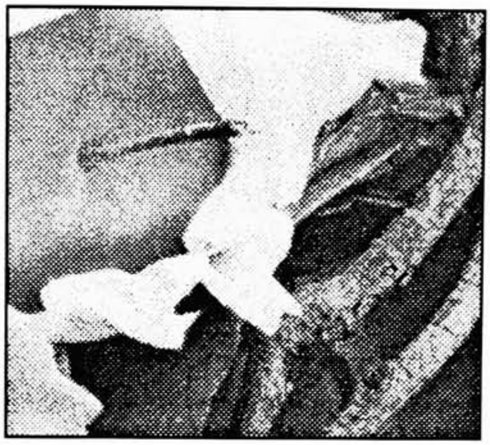


Figure 94

COLOR LASER WITH VARIABLE DOT STOCHASTIC SCREENING

The major advantage of a color laser printer which uses variable dot stochastic screening is its ability to print nearly continous tone imagery. As stochastic dots are varied in size and placed closer and closer together, they appear to blend into each other even at a normal viewing distance of approximately twelve inches from the unaided eye. The following three samples of imagery (figs. 95, 96, and 97) barely display recognizable image dots even at a magnified view. They were printed on a Lexmark Optra C at 600 dpi. Notice that although tonal gradations may seem rough in the magnified views, shading and gradations viewed in the overview of Figure 97 seem much smoother than either of the previous two color laser process samples which use halftoning and fixed-dot stochastic screening.

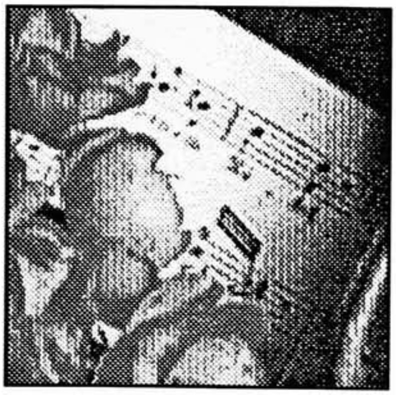


Figure 95

Figure 96

Figure 97

DYE SUBLIMATION

Dye sublimation proofers produce high quality continous tone imagery and graphics. By far, the qualities of their output surpass those continuous tone qualities of any of the low-end to mid-range color output device processes previously displayed in this chapter. Unfortunately, dye sublimation proofers cannot display vector based graphics and text at a higher resolution then they print continuous tone imagery. Just as typographic elements suffer from a 300 dpi print resolution, so do the fine lines and details of vector based computer illustration. The limitations of the dye sublimation process in regards to vector based illustration may be seen in Figures 98 and 99.

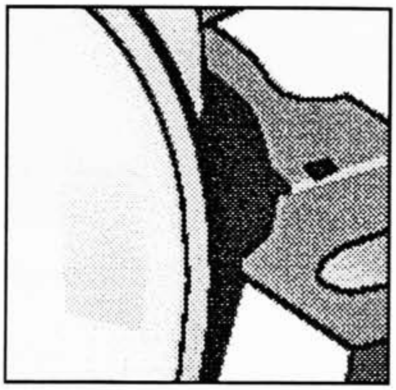


Figure 98

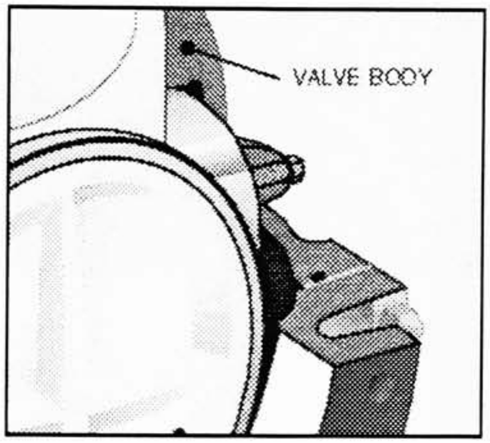


Figure 99

These samples (figs. 98 and 99) were printed on a Tektronix Phaser 440 proofer at 300 dpi. The drawbacks of this low resolution may especially be seen throughout the thin linework present in Figure 98. Sharp, jagged edges appear on all curves. Although the dye sublimation process fails to smooth such thin curved lines, it does produce extremely smooth vignettes and other color gradations which are almost always present in 2–D and 3–D vector based illustration.

Their ability to produce smooth gradations throughout continuous tone imagery is apparent in Figures 100 and 101 which were printed on the same Tektronix Phaser 440. Unfortunately, as the dye sublimation process blends the edges of pixels, sharpness and edge definition are lost in all photographic imagery. This loss of definition may be observed in the strands of hair and eye brows present in both samples.

Figure 100

Figure 101

In addition to the loss of definition of small details in the photographic imagery printed by the dye sublimation process, loss of detail modeling in the highlights and shadows of imagery is also common. In Figures 102 and 103, loss of modeling in the cap of the light, pink marker is much greater then the loss of modeling in the medium-tone blue marker caps.

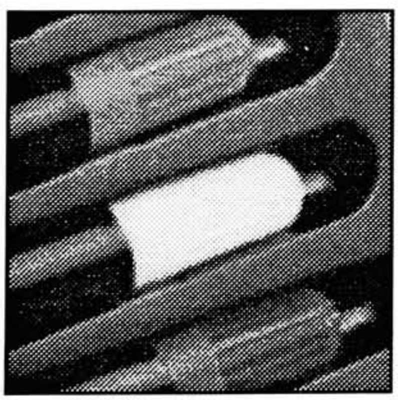


Figure 102

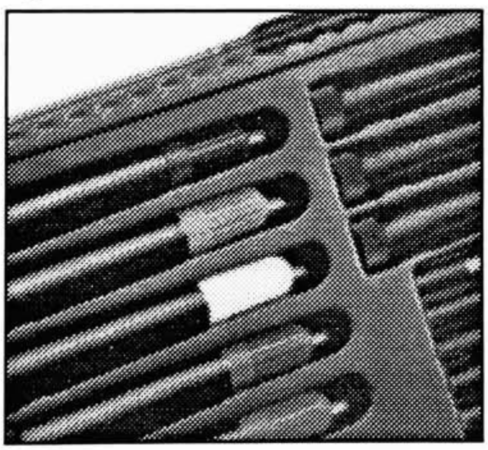


Figure 103

Continuous Inkjet

The continuos inkjet process produces continuous tone imagery which rivals the quality of the imagery displayed by the dye sublimation process. Although the overall user selectable printing resolution of most continuous inkjets (such as IRIS Realist or the 3047) is only 300 dpi, as many as 31 droplets of liquid ink for each process color may be applied to the substrate to represent one pixel of imagery. Coupled with high-end color management software, this system of droplet placement lends IRIS proofers the ability to produce output with extremely accurate color and an unprecedented color gamut. According to Iris Graphics, Incorporated, this system also allows IRIS proofers (all of which are capable of the above ink droplet placement) to create output which appears to be printed at 1500–1800 dpi (IRIS, Iris Continuous Inkjet Technology, 1996). Such a high resolution due to droplet placement also enables the continous inkjet to display excellent amounts of detail in the lightest highlights and the darkest shadows. It should be noted, however, that the "continuous tone appearance of an IRIS continous inkjet proof does display halftone patterning. This patterning is most apparent in Figures 104 and 105 which display vector based graphics.

Figure 104

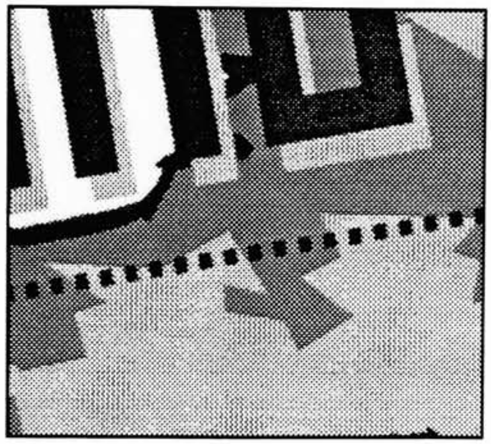


Figure 105

The halftone screens common to IRIS continuous inkjet proofs may also be seen in Figures 106 and 107. Although they are vividly apparent in the magnified view of Figure 106, the halftone dots blend to present a continuous tone image at a normal viewing distance of approximately 12 inches away from the unaided eye.

Figure 106

Figure 107

Dye Ablation

Generally speaking, the dye ablation process, such as the one found in the Kodak Approval system, displays imagery with amounts of fidelity and color accuracy that surpass those found in continous inkjets. As explained in the process supplement, the Approval systems also have the advantage of displaying halftone patterns similar to those used in the offset lithographic printing process. The following samples of graphics and imagery display the image fidelity and sharpness available with an Approval proof printed at 1800 dpi. Notice the fine screening sharp edges and even patches of solid color throughout the graphics displayed in Figures 108 and 109.

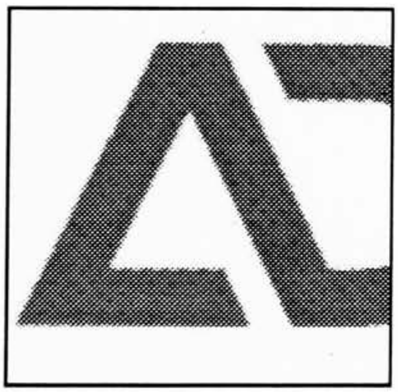


Figure 108

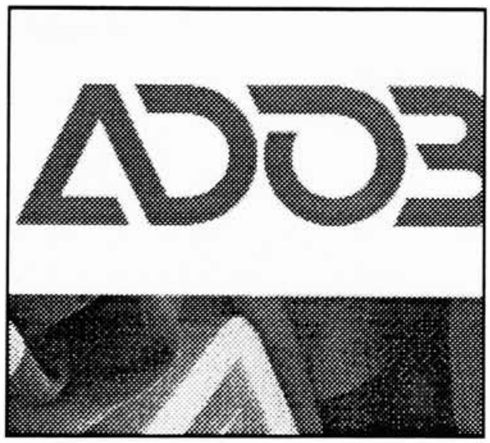


Figure 109

In the photographic imagery of Figures 110 and 111, one may observe the distinct roset pattern which is used in all halftone based lithographic printing. The roset pattern is visible in Figure 110 as what appears to be small, circular shapes with a dark dot in the center. Proofing at such a high resolution with extremely accurate color promotes highlight and shadow detail as well as smooth tonal gradations and true memory colors. Examples of detail and proper memory colors may be seen in the hair and face of the woman in Figure 110.

Figure 110

Figure 111

Chapter Six

The Acceptance of Digital Contract Proofing

Chapter 6: The Acceptance of Digital Contract Proofing

The New Definition of a Contract Proof

What is a so called contract proof? Must it have halftone dots? Or, should it be a continuous tone print which has the appearance and qualities of original photographic imagery? Which proofing technologies are acceptable? How accurately does the contract proof have to match the color of the printed piece? How accurately must it match spot colors? How should it appear physically? Should it have a glossy, finished surface no matter what the actual substrate for the job may be? Should it have a surface which matches that of the final substrate? Or, should it be proofed *on* the final substrate? One may even ask, who produces a contract proof—the prepress provider or the creative professional?

These are all questions which help define the phrase "contract proof."

The New Definition

As the evolution of digital proofing continues, so do its affects on the definition of a contract proof. Digital contract proofs and the technologies which produce them have given the designer more creative leeway, let them choose one or more output technologies best suited for their line of graphic work, enabled designers and prepress providers alike to proof earlier in the creative and production processes, and saved all participants time and money. With all of these advantages and new options, designers and prepress providers may even opt to send a proof around the world in less than 10 minutes with remote digital proofing. Or, they may print several versions of a completed job in near contract quality color with less expense than outputting *one* set of films and creating *one* conventional proof. In fact, there are so many advantageous choices regarding digital contract proofing systems and their technologies that all users must have extensive education to choose and apply them properly.

Without education and proper application, an improper choice of a digital proofing system will lead to lost productivity and profit. Just as it was possible to improperly apply the 3M Matchprint conventional proofing system when it first became popular throughout the industry, so is it even more likely to improperly apply one of many digital contract proofing systems and their technologies. For these reasons, it comes as no surprise that digital contract proofing has only cautiously been accepted by mid-range and high-end commercial printers and their clientele. Analogously, the history of the DuPont Cromalin, now one of the most widely accepted conventional proofing systems, is similar. It too was not willfully embraced upon its introduction because users could not separate the process color layers as they could with a Color Key. With a Color Key proof, it was possible to look at each process separation because they were simply placed one on top of the other without any type of adhesive or fusing process. At the time, users were more comfortable with this approach. Of course, after its introduction and eventual extensive use, the Cromalin and other similar conventional systems surpassed the quality of the Color Key approach. This example serves as a simple reminder that the industry-wide acceptance of any new technology, in this case several new technologies, comes only after extensive application of that technology by all of its users in the graphic arts community. The acceptance of digital contract proofing systems and technologies in all levels of the printing and graphic arts industries is inevitable.

As one begins to eliminate the variables of proper application, education, and industry acceptance, it becomes easier and easier to answer the question, "what is a contract proof?" However, it is important to remember that, even more so than with conventional contract proofing systems, one user's definition of a contract viable digital proof is likely to be different from another user's definition simply because of each user's different proofing application. With this in mind, the new, universal definition for a contract proof could be stated as follows:

> *A digital contract proof is considered to be a form of digital output (in either black and white or color) that signifies an agreement between the art director or print buyer and the print provider that what appears on that output is a satisfactory match to the final printed piece.*

The true difference between this definition of a contract proof, and the definition which has been previously followed by the industry, is the phrase, "satisfactory match." Previously, a contract proof had to match, as closely as possible, the look and feel of the press sheet. With so many different digital proofing technologies which each present a different image quality and amount of color accuracy, any proof which has the ability to match the press well enough for the approval of the client has become part of a more practical application of contract proofing.

Standards in the Agreement

As the new definition of a contract proof is based upon an agreement between the art director/print buyer and print provider, there must be a basis for this agreement regarding the qualities and color accuracy of the digital proofing system to be used. This basis consists of several fundamental standards which must be realized and met for an agreement to occur. The answers to a select few of the questions at the beginning of the chapter may be used to create and/or address this group of standards. In the following paragraphs, each relevant question is stated and simply answered to practically inform the designer and art director what to consider when utilizing or opting for digital contract proofing.

Must a contract proof have halftone dots?

When deciding upon the answer to this question, one should at least note the following two factors. Firstly, it should be recognized that the only contract proofing processes which display the same exact halftone dot patterns which appear on press are conventional ones. The exception to the rule is the Optronics Intelliproof. The Intelliproof system uses the same raster image processor (RIP) to image both the screens which are displayed on the proof and those on the films to be used during platemaking for the press. However, even an Intelliproof does not replace the comfort of the direct relationship between a *conventional proof* and its films.

The second factor to be noted involves the cost of the job at hand. Simply stated, the greater the cost of the job, the more likely it is that the client and print buyer will desire a widely used, extremely dependable proofing system—in this case and at the present time, probably a conventional one. Throughout the industry, digital contract proofs with halftone dots, such as those made by a Kodak Approval, have only been accepted by those who are producing mainly mid-range and a small amount of high-end graphic art. This is due to the fact that most prepress and print providers working at these levels have found it profitable to utilize either halftone based digital proofing systems, conventional proofing systems, or a combination of both. Profitability is a direct result of consistently high rates of success when attempting to produce a proof to press match.

In conclusion, a proof with halftone dots for proofing high-end graphic art is still most likely to be produced with a conventional system. As the level of quality drops, the use of digital proofing increases—mid-range jobs with halftone capable digital proofers and low-end jobs with continuous tone proofers. In any case, one is almost always obliged to use the proofing system that is made available by the provider. However, this does not mean the creative professional should refuse the chance to try digital proofing in conjunction with the production process of such high level graphic art. As acceptance of digital proofing with all levels of printing continues, such a chance becomes more and more likely to occur.

WHICH PROOFING TECHNOLOGIES ARE ACCEPTABLE?

As mentioned in the answer to the previous question, digital proofing in the high-end of printing is currently being accepted in one form—the Kodak Approval. However, even the Approval has only lightly captured some of this market. It is mainly accepted in the mid-range of printing applications. Also in the mid-range of printing, IRIS continuous tone proofs have been widely accepted where the Approval has been too expensive to implement. In the low-end of printing applications, those which require the least amount of color accuracy, dye sublimation proofs are widely accepted. Also in the low-end are most all of the other color printing and preproofing technologies have been accepted as digital contract proofs simply because accurate color is not of great concern.

HOW ACCURATELY DOES THE CONTRACT PROOF HAVE TO MATCH THE COLOR OF THE PRINTED PIECE?

The answer to this question is also based on the cost of the job at hand or the level of quality required for the production of a specific job. The lower the quality, the less color accuracy. A lower amount of color accuracy permits the use of less expensive color printers and digital proofers which may output continuous tone imagery or PostScript-based, device specific halftoning.

HOW ACCURATELY MUST A PROOF MATCH SPOT COLORS?

For the time being, this question must not be overly important. Because all digital printers and proofers display spot colors by printing their process color equivalents, no digital output device has the ability to accurately match spot colors. The best alternative for the art director who uses digital contract proofing is to note which spot color hues vary the most from their true spots. If more than one type of digital proofer is used, then the art director must note a different set of poorly simulated spot colors for each type.

HOW SHOULD A PROOF APPEAR PHYSICALLY?

This is one question which may still be justified and answered according to the old definition of a contract proof. It is always important to try to proof with a system, be it a digital or conventional one, that simulates the appearance of the press sheet. If the press sheet is newsprint, then ideally, the proof should appear on newsprint as well—or at least have the yellow-whiteness of newsprint. If the press sheet is coated or uncoated, the proof should appear on coated or uncoated stock of similar brightness respectively. Likewise, if the press sheet is a colored or recycled paper, then the proof should be output on that same stock. As mentioned in earlier chapters, many color printers and digital proofers have the ability to create output on a variety of substrates. If the substrate of the press sheet cannot be used to proof upon, then at least have the proof appear on stock with a similar surface quality and/or brightness.

WHO PRODUCES A CONTRACT PROOF? —THE PREPRESS PROVIDER, OR THE CREATIVE PROFESSIONAL. . .

Only with the evolution of digital proofing has this question arisen. In the past, with the strict use of conventional proofing systems, prepress or print providers were the only participants in the production process who had the ability to output contract proofs. Presently, and especially in the low-end of graphic arts reproduction where color accuracy is not of major concern, the creative professional may produce the contract proof with an inexpensive color output device. When handed to the prepress or print provider, such a proof is almost always thought to display pleasing color only, and the understanding of variations in the appearance of the proof as compared to the press sheet are completely comprehended by both parties.

The answers to the above six questions begin to serve as guidance to the creative professional who intends to make use of digital contract proofing. The simple guidance they present will help one decide when and where to apply digital contract proofing. It will also help to formulate one's own definition of a digital contract proof. This is important because every graphic reproduction requires a different amount of image quality and color accuracy. Remember, a contract proof is only as good as the agreement between the creative professional and print provider behind it.

Applying the Digital Contract Proof

After the above standards pertaining to the quality and color accuracy of a proof have been agreed upon by the creative professional and print provider, the next ideas which aid in the proper application of digital contract proofing may be realized in the concepts of Closed and Open Loop Systems. In the introduction to this guidebook, Closed Loop systems are defined as the entire reproduction process of graphic art performed by one prepress and print provider. All scanning, proofing, and printing is done by one provider or a prepress provider working closely (abiding by the same production standards) to a printer. An Open Loop system is defined as a prepress provider which scans, assembles, and proofs a job, but does not do so by the specific standards of a known printer and press. Instead, the standards which are adhered to are most likely to be industry-wide standards such as SWOP or SNAP. More information on these standards may be found in the *Color Primer*. In this chapter, conditions surrounding the two concepts of Open and Closed Loop systems are expanded upon. They are presented and defined in their ultimate forms for purposes of simplification and the promotion of confidence related to the creative professional's choice to utilize digital contract proofing. However, it is important to note that in the working environment of the graphic arts industry, the concepts of Open and Closed Loop systems will be less defined.

Both Closed and Open loop systems demand a different amount of quality and color accuracy from the proofing systems utilized within them. The agreement between the creative professional and provider must consider which system

(Open or Closed) a digital contract output device will be sufficient for according to the requirements of quality and color accuracy demanded by that system. This is another step in the proper application of any digital contract proofing device.

Proof to press variables and required amounts of proof image quality and color accuracy are all discussed in accordance to each of the two particular systems in the sections below.

Closed Loop Systems

A broader selection of digital proofing systems meet the contract requirements of the Closed Loop system. To explain why a greater number of digital proofing systems are available for use in a closed loop, the components and variables involved must be noted by the art director or other creative professional. For the most part, the reason resides in the fact that a Closed Loop system enables the prepress provider to eliminate more proof to press variables. As more variables are eliminated, calibration of any digital proofing system to a press becomes simpler.

There are two major components to both Closed and Open Loop systems. The first is the prepress provider (also called a trade shop), and the second is the printer. In a Closed Loop system, the relationship between the two is much closer. The ultimate definition of a closed loop system in regards to this relationship includes the following factors:

- The prepress provider has a strong working relationship with the printer.

- All prepress variables regarding scanning and color correction have been automated with a set of standard procedures.
- The prepress provider is aware of the printing process and press attributes present for the job at hand. Basic attributes include the following: ink set (color gamut of the inks used for printing), press dot gain, substrate.
- The prepress provider works by the same color matching standards with an automated color management system aimed directly at a specific press owned by the printer upon which the job will be run.
- If prepress workflow is not aimed at a Computer-To-Plate printing process, all variables surrounding an imagesetter are automated and/or eliminated by the calibration of the imagesetter to the printing process and press attributes.
- If prepress workflow is aimed at a Computer-To-Plate printing process, all digital proofing is constantly calibrated directly to the press and its attributes.

All of these factors help the prepress provider to create proofs for a specific printing process and press. Essentially, any testing regarding proof to press calibration is focused on a *specific* target (printing process and press) instead of a *common* target. The idea of prepress for a common target applies to an Open Loop system. By calibrating a digital proofing process directly to a specific target, variables mentioned above such as those which involve scanning, imagesetters, dot gain, ink color gamut, and substrates may all be taken into account. As these variables are each noted and/or eliminated, the calibration of a digital proofing system may occur with the highest quality proof to press match capable of being produced by that specific digital output device. Note that the status of all of these variables must be maintained and monitored for the closed loop system to maintain such a high quality proof to press match. Besides maintenance, the other most important benefactor of such high quality matching is the ability of the prepress and print provider to set standards regarding how far off any of the above essential variables may sway from the norm.

With all of these variables under consideration or eliminated, any digital proofing system with *color and tonal correction software* may be used to simulate the press sheet. Of course, the quality of the output from the chosen digital proofing system will probably be directly related to how costly the job at hand may be. A higher cost job demands a closer proof to press match. Lower cost jobs do not. The decision of which proofer to implement, and whether or not it must display halftone dots is left to the prepress provider in most Closed Loop systems. This is due to the fact that all providers implement a proofing device which fits their workflow and is most profitable to their operation.

Open Loop Systems

In contrast to the Closed Loop system, an Open Loop system requires that the utilized digital proofing device displays a higher level of image quality and more specific tonal and color control. Its ability to compensate for almost any proof to press variable is of utmost importance—for in an Open Loop system, the prepress provider has only common or general printing process and press targets to aim for. Such a *common target* consists of many proof to press variables which may not be eliminated. Lower cost, less sophisticated digital proofing systems are not able to compensate for many of these variables. Therefore, only high-end digital proofing systems which are able to compensate for a variety of proof to press variables should be utilized in an Open Loop system. Additionally, the utilized proofing system should, as closely as possible, simulate the printing process. Digital proofs with halftone dots are able to simulate the offset printing process the best.

Although the two major components of both Open and Closed Loop systems are still present (prepress provider and printer) in an Open Loop system, they no longer carry on a close working relationship. The ultimate definition of an Open Loop system in regards to the lack of such a relationship includes the following factors:

- The prepress provider has most likely not worked with the printer. No long term working relationship exists.
- All prepress variables regarding scanning and color correction are calibrated to industry standards—not printer specific ones.

- The prepress provider is aware of the printing process but may not know the printer's standards regarding any of the following press attributes: ink set (color gamut of the inks used for printing) or press dot gain.
- The prepress provider does not work by the same color matching standards as the printer. They do however provide proofs and/or films which abide by industry standards for color accuracy.
- If prepress workflow is not aimed at a Computer-To-Plate printing process, variables surrounding the utilized imagesetter are generally calibrated to the printing process. These variables include film processing temperatures and speeds which directly affect halftone dot size on the final films. A properly calibrated imagesetter will produce films with halftone dot sizes set by the provider to compensate for known amounts dot gain according to the printing process.
- Due to the required integration of prepress and press related systems within a Computer-To-Plate workflow, Open Loop Systems are not a viable option for CTP operations.

All of these statements imply that Open Loop systems require prepress providers to output proofs and films which abide by industry standards such SWOP or SNAP. Production of materials which meet industry standards are certainly not as tuned to a specific printing process and press as they might be in a Closed Loop system. Therefore a lower quality proof to press match is likely to preside in such a system. However, remember that films and proofs which have been created in accordance to industry standards are still considered to be comprised of good image quality and color accuracy. Any lack of image quality and color accuracy which still resides within the variations provided for by industry standards may usually be compensated for by adjustment of the press during the press run.

In conclusion, the Open Loop system presents more color and image related variables to compensate for during the output of proofs and films. Therefore, the prepress provider will adopt a digital proofer for use in an Open Loop system which lends that provider the greatest amount of quality control possible. The output of the chosen proofer will also need to simulate any of the printing process characteristics which are known to the provider such as halftone dot patterns. Simulation of known printing process characteristics such as halftone dots will help the press operator to compensate for any lack of image or color quality on the proof when attempting to make the best proof to press match.

For the creative professional who desires to use digital contract proofing in an environment similar to that presented by the concept of an Open Loop system, it is of utmost importance to insist upon the use of an extremely high quality digital proofer due to the myriad of variables which their prepress provider must address during the reproduction process.

Fingerprinting A Press and Press Run with Digital Proofing

One of the most advantageous qualities of all contract viable digital proofers is their ability to fingerprint a press on a specific press run more aptly than most conventional proofers. This quality is another benefactor for those creative professionals who are considering the use of, or are already involved in the use of, digital contract proofing. Fingerprinting a press and the many variables specific to a press run involves the ability of a digital contract proofer to adjust its output for press and job specific attributes. Four major attributes which may be compensated for are explained in the following sections. Three of them, dot gain, printing ink color gamut, and printing ink contamination are press specific attributes. The fourth, substrate brightness, is specific to the press run/job at hand.

Dot Gain

Dot gain refers to a defect in the printing process which enlarges the size of all halftone dots printed by the press. Enlargement of halftone dots promotes the overall darkening of imagery and the darkening of colors. All presses produce a specific amount of dot gain. A digital proofer may compensate for a known amount of dot gain by lightening its overall output and desaturating or lighting colors. Note that this lightening of output imagery is considered by many to be affective in the task of compensating for dot gain even by contract viable digital proofers that do not display halftone dot patterns on their output.

Printing Ink Set Color Gamut

The color gamut of the process inks used to print a specific job varies with the qualities and colorant in any given ink set (a set of C M Y K inks). The achievable color gamut of a given ink set is directly related to the pigments used to produce each of its process color inks. Through color correction software, digital proofers lend the user the ability to simulate the color gamut of a known ink set.

Printing Ink Contamination

The pigments of printing inks are not perfect. They do not reflect only one color of the visible spectrum. Each process color ink, depending on its manufacturer, reflects a small bit of one or more of the other subtractive colors (C M or Y). The amount of this excess color reflection is referred to as the amount of process ink contamination. The amount of contamination present in each of the process color inks is completely dependent on the ink set used by the printer for a specific press. If the amount of contamination is known by the prepress provider, it is possible through color correction software to purposefully contaminate the process colors of the utilized digital contract proofer.

Substrate Brightness

The brightness of a white substrate varies from reproduction to reproduction. Some designs will be printed on highly whitened paper while others may use newsprint. Whether the utilized substrate is a bright white or a dull yellow gray, the imagery which appears on that substrate is directly influenced by it. A bright white substrate will brighten the highlights of an image, while a dull yellow gray substrate will darken the highlights of an image. Whichever the case, properly implemented color correction software available with most contract viable digital proofers can compensate for the brightness or dullness of a given substrate. Implementation of color correction software for this purpose is required when one is not able to use the final substrate for proofing purposes. Compensation for substrate brightness or dullness is made possible by printing a proof on a bright white substrate with imagery influenced by a purposefully created color cast. The applied color cast is similar in appearance and hue to the one found on the final printing substrate.

Acceptance and The Education Factor

The most important concept which directly affects the acceptance of digital contract proofing systems is user education. Art directors and designer's alike will only accept the output from a digital proofing system as contract worthy output when she or he learns more about that system. There are several methods which one may use to learn more about any contract viable digital proofing system and its output.

One major method is through comparison and observation of similar digital and conventional contract proofs. As many prepress providers begin to use digital proofing systems, the creative professional will have the opportunity to view and/or request both digital and conventional contract proofs for one job. This comparison will familiarize both the art director and print buyer with the appearance and image qualities belonging to a specific digital proofing system's output. Mental compensation for image and color quality differences between digital and conventional proofs may also be noted during the time of comparison. Mental notations help familiarize and comfort the viewer who is contemplating the use of digital contract proofs.

Another reason to compare both forms of output is that, chances are, the manufacturer of the digital contract proofing system has matched its digital output image and color quality standards to those image and color quality standards used for its conventional proofing system.

Another major method to education regarding the use and eventual trust in digital contract proofing systems is one of demonstration. Most major manufacturers make it possible for a prospective user to proof a current job with their digital output device. Demonstrations also usually involve background material in the form of printed copy to further educate a prospective user even more so about a specific proofing system and its form of output technology.

In conclusion, it is both the responsibility of the prepress provider and creative professional to learn as much as possible about contract viable digital proofing systems which apply to their lines of work. The procedure of finding out which preproofing and contract proofing systems are applicable to one's line of work is facilitated by this book, *A Designer's Guide to the Evaluation of Digital Proofs.*

Glossary of Useful Terms

Glossary of Useful Terms

banding

Subtle inconsistencies in the smoothness of spot color screens and fades.

base

See Conventional Proof definition below.

callout

Calling out a spot color or PMS color refers to placing a tag or swatch of a specific spot color seen in a layout on top of the proof or preproof. This tag notifies viewers of a specific spot color which is to be printed in addition to the four process colors.

carrier sheet (carrier)

See Conventional Proof definition below.

color and tonal correction software

Software available with digital color output devices which allows the user to make corrections for color accuracy and adjust lightness or darkness of the highlights, midtones, and shadows of output. As the cost and sophistication of an output device increases, so does the sophistication of the color and tonal correction software available with that device.

color overprint

The resulting color and color field when two halftone dots overlap each other. The amount of overlap represents the color field and the color of the overlapping area represents the resulting color.

conventional proof (also referred to as an Analog Proof)

Most analog proofs are created using similar technology. An analog proof is made directly from the film separations output by an imagesetter or created by means of graphic arts photography. Each film separation, one for each of the process colors, is used to expose a process color carrier film over a base. Prior to exposure, the dye from the carrier is laminated onto the base. After exposure, the base and dye from the single carrier are developed. Depending upon the system, the non-image areas of the carrier layer are washed away, leaving the dots of the specific process separation on the base sheet. This procedure of exposure and development is repeated four times, once for each process color. With every exposure, the specified film is registered (by hand) onto the preceding layer. When completed, the base has been processed four times, and displays overlaid dots from each of the carrier sheets. The result is a finished image with the same halftone patterns found on the films which (upon approval) will be used to create plates for the press run.

closed loop system

A complete printing system where the same print provider scans original artwork, creates films (if required), proofs all artwork, and prints an entire job in-house.

color gamut

Color gamut is the term used to refer to the range of colors which are reproducible by the four process colors cyan, magenta, yellow and black.

Computer to Plate (CTP)

A prepress system which has been developed for use with desktop or digital publishing. In a computer to plate prepress system, the process of creating films from digital files never occurs. Instead, digital file image information is imaged directly onto plate material by a platesetter, or onto printing plates by a digital press.

color proof reader's marks

Within this guidebook color proof reader's marks are those symbols used to correct color prints and digital proofs for the purpose of communicating with a prepress provider.

color transfer rolls

rolls of thin plastic film used in digital proofers which carry a thin coating of process colored wax or dye. Depending upon the proofing process, dye or wax from a color transfer roll is transferred onto the substrate by pinpoint areas on a thermal print head.

contone

A digital proof or color print which displays no halftone dots representing those which will be found on the final press sheet.

contract viable

A term used in conjunction with a digital or conventional proof meaning that the proof in question is of the proper quality to accurately represent the final printed product. A contract viable proof is one which may be expected to match the final printed product..

contract proof (definition which was most often applied to conventional proofs)

A digitally or conventionally produced page(s) which, as closely as possible, matches the look and feel of the final printed piece. A contract proof is produced before the press run.

contract proof (the new definition presented by this guidebook)

A digital contract proof is considered to be a form of digital output (in either black and white or color) that signifies an agreement between the art director or print buyer and the print provider that what appears on that output is a satisfactory match to the final printed piece.

Contract Viable Digital Proofer (CVDP)

A term specific to this guidebook referring to a digital proofer capable of producing contract viable color proofs.

Direct Digital Color Proofer (DDCP)

The graphic arts industry's term for a contract viable digital proofer which is used as part of a filmless printing system.

first generation proof

The first proof to arrive from a prepress provider (often a contract proof) requiring corrections by the print buyer and art director. The term *first generation proof* may also refer to the first preproof produced by a designer which requires corrections pertaining to element positioning, text flow, etc.

for position/placement only (FPO)

A term used in conjunction with a digital proof meaning that the proof in question displays only the position of design elements, text flow, pleasing however non-accurate color, and the overall fidelity of the layout. An FPO proof is not contract viable.

high key image

A high key image is one that consists mainly of light subject matter. Light subject matter is considered to be that which may be reproduced with shades of color or gray below the ≈70% percent halftone dot level.

hit

An extra hit on press refers to printing an extra color during the printing process in addition to the four process colors.

hue (in regards to color characteristics)

A hue of color is the name of a color. The color red's hue is "red".

lightness (in regards to color characteristics)

A color's lightness is a measurement of how light or dark its equivalent shade of grey would appear. An equivalent grey shade is simply a color's appearance with no saturation.

low key image

A low key image is one that consists mainly of dark subject matter. Dark subject matter is considered to be that which may be reproduced with shades of color or gray above the ≈30% percent halftone dot level.

misregistration

the improper alignment of process color separations during the printing or proofing process. Misregistration leads to blurred imagery and process colored text.

open loop system

A prepress system where the provider scans artwork, creates films, and outputs proofs. In contrast to a closed loop system, the open loop system provider does not print the job in house.

pleasing color

describing the bright and contrasty, yet inaccurate, colors which most color printers and preproofers display on output.

preproof

A proof which displays only the position of design elements, text flow, pleasing however non-accurate color, and the overall fidelity of the layout. Preproofs are all digital proofs created preceding the output of a contract proof.

press run

The operation of a printing press for the production of a final printed piece.

press sheet

A press sheet is the final printed product which from the printing press into the hands of the client and print provider. Both client and print provider are most likely to observe the press sheet before it is folded or trimmed.

press attributes

Press attributes are the specific operational characteristics of a press. Some of these characteristics include: wet or dry color trapping, dot gain relative to substrate, speed, printing process – gravure, offset, flexographic, etc.

print engine

The term print engine refers to all of the components (including print head and software which decides where to place halftone dots and vector or PostScript imagery) which enable an output device to produce process color output.

process color separations

In the context of imagesetters, a process color separation is an image on film (burned onto the film by the laser of the imagesetter) which will be used to create the cyan, magenta, yellow or black plate through light exposure and chemical development of the plate material. To create a process color image, four process color separations must be imaged by the imagesetter—one each for cyan, magenta, yellow, and black.

reflection densitometry

Reflection densitometry uses a reflective densitometer. A reflective densitometer reads the density of the process colors which appear on a print, proof, or press sheet. In regards to digital proofs, reflection densitometry is used to calibrate the densities solid, process color patches on proofs to those found on actual press sheets.

remote proofing (sites)

The action of sending and proofing digital files to multiple users at different geographic locations using the same digital proofer or color printer for output.

repeatability

The ability or disability of a color printer, digital proofer, or other imaging devices to create consistent output from job to job or from proof to proof. The factors of consistency in question include color, sharpness, and overall image fidelity.

saturation (in regards to color characteristics)

The saturation of a color is a measure of its brightness or "punchiness".

signing off

To sign off is to approve of, by means of written contract, the sufficiency of a contract proof. One signs off on a contract proof when he or she approves of the imagery it displays in addition to the belief that it represents the final printed product.

simulated spot colors

Simulated spot colors are those which have been created by the use of the four process colors.

spot color

Spot colors are those which may not be perfectly represented by a combination of either cyan, magenta, yellow, or black. A true spot color is one which must be printed by adding another color to the printing process.

spread and choke

When trapping an object, the spread/choke concept involves the enlargement and reduction of two color areas around a common boundary to prevent unwanted paper color from showing through on the final press sheet.

tone (in regards to color characteristics)

The tone of a color is a measurement of its lightness or darkness.

trapping (for the graphic arts)

Trapping is the action of creating amounts of spread and choke to prevent unwanted paper color from showing through between two differently color areas on the final press sheet.

true spot color

A spot color which has not been reproduced using the four process colors. A true spot color is often a Pantone color which is custom mixed by the printer.

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Appendix B

Compilation of Questionnaire Information

KEY:

QQ=Quadracolor
EG=Empire Graphics
CT=Canfield and Tack

RH=Rumrill Hoyt
WL=Winterkorn Lillis
HYR=Hutchins Y&R

Questionnaire One

Section One: *Digital Proofs with Halftone Dots—Tests and Corrections*

1. What are some advantages to having halftone dots on proofs?

QQ: Identical representation from proof to press; pressman familiarity
EG: directly related to what occurs on press; corrections and changes are listed in halftone dot form; color differences can be detected and estimated by visual inspection
CT: Assists in making judgements regarding color correction; closer to true press sheet, therefore gives pressman a guide toward maximizing color; moire patterns and misregistration show
RH: changes in dot percentages can be viewed; quality level expectations are greater with a higher level proofing system such as the Approval; closer match to press sheet
HYR: direct correlation to press sheet; general substrate consideration (mostly for coated stocks)

2. What are the most frequently used tests performed on HT digital proofs

EG: test patterns run periodically throughout the day; solid patches checked for density values
CT: watch for moire patterns
RH: look for color value changes; visually (subjective)

3. Is there a standard set of color proof reader's marks which are used when correcting these proofs?

EG: most changes are concerning color–these changes are listed according to the color and dot percentage to be changed.
Examples: H.L.=highlight; 1/4T=quarter tone; M.T.=mid tone; 3/4T=three quarter tone O.A.=overall; +=plus; -=minus
(all these plus a percentage quantity)

NOTE: It is best to keep the art director "talking" about what they feel needs to change with the proof. By compiling comments on several objects in the proof, one can put together the technical cause for the problem. This is to say if several objects have a tint, darkness, etc., than it may be to much of a process color or a curve which needs to be adjusted.
RH: +/- CMYK; flatness; contrast; highlights; clothing comments; check alignment of elements.

4. Which more extensive texts may be performed on HT digital proofs?

EG: reflection densitometry if necessary

5. Do moire patterns show up accurately on your halftone dot proofing system?

EG: yes—however moire patterns can change with relation to the difference in film plotters to proofers. Film angles, dot shapes, resolution, etc.

Section Two: *Digital Proofs Without Halftone Dots—Tests and Corrections*

1. What are the advantages of proofing with a CT proofing system?

EG: cheaper equipment and consumables
QQ: Inexpensive; Digital/Single Pass – faster, moire flexible. The ability to make change and show a new proof in under an hour.
HYR: in house; low cost; quickly accomplished; eliminates need for film (for closed loop system or short run on demand with Xerox Majestic); duplexing possible with Xerox Majestic
CT: low cost; speed

2. What are the disadvantages of CT proofers?

EG: no direct relationship to press; predictability is unsure (due to repeatability of proofer?); corrections must be interpreted form CT to dot.
QQ: resolution is lower – edges are less distinct, line art and text not exactly representational (it tends to be courser and/or thicker)
HYR: upgrades in software to integrate; not a true halftone representation; heavily saturated (on Xerox Majestic); limited substrates
CT: unacceptable to many print buyers
RH: overall colors don't match
NOTE: if shown to a client, client will expect contract proof to match FPO CT/prelim. proof.

3. Where is CT proofing used most often: comps, less costly job orders, by request of the client, preceding the contract proof?
EG: comps only
QQ: in QQ's closed loop system with a Heidelberg GTO-DI -> contract proof
RH: Iris prints are best pre-contract proofs; Iris proofs used as props in photo shoots

4. What types of tests are possible with CT proofs?

EG: Only checked for positioning etc. No prepress related testing possible except with Iris proofs.

5. Is there a standard set of color proof readers marks for CT proofs?

EG: same as with halftone dot digital proofers

Section Three: *Setting Standard Correction Procedures*

1. Do standard correction procedures take place on all proofs?

EG: Yes—ask for examples!!! (see #4)
QQ: proofs go out; customer marks up; sales explains to production; production makes changes.
HYR: usually one go around; at least two proofs; float parts of proofs for cost efficiency; blue lines are requested
CT: most correction is done on the basis of float proofs – proofs of the scanned images before page assembly
RH: float proofs for cost efficiency

2. What types of corrections are needed most often?

EG: color corrections to come closer to originals or a "perceived" idea of a customer; color corrections to help bad originals
QQ: localized color correction, positioning of elements
CT: color shifts between transparency and separations

3. What types of corrections are most often misunderstood/confused with others?

EG: no set pattern
QQ: color specifications
HYR: contrast questions; midtone highlights; control of certain areas; saturation levels; levels in general
NOTE: designers are "CT people—not HT people"
RH: overly specific comments by print buyers/art directors

4. Is there a good place to start when setting up correction procedures?

EG: follow logical progression for info needed—Exemplary notation:
+ M MT 10% OA
(plus or minus) (color correction to what ink:YMCK, 4/C) (portion of dot area curve affected) (percent dot amount) (over all or is mask needed?)
QQ: Direct sales interaction

Section Four: *Checking and Correcting*

1. What corrections pertain to the following parts of a proof (excluding FPO proofs): CMYK imagery, spot colors, duotones, type, image fidelity/sharpness.

EG: CMYK imagery – mostly color correction or color balance, some corrections for overall brightness (to be more open than the original)
Spot Colors – check for moire patterns, check for fit
Duotones etc. – same as CMYK except with PMS colors
Type – integrity of fonts, reverse type bold enough for printer to hold
Image fidelity – type within a product shot must be as sharp as possible, some subjects must be reproduced at an increased resolution due to subject matter (automobile chrome)
NOTE: these corrections are done in a variety of areas such as scitex, mac, etc.

QQ: NOTE: QQ uses Iris as contract proofs
CMYK imagery – colors +- x% in specific areas
Spot colors – callout to be spot on press
Duotones – colors +- x% in specific areas/densities
Type – flow, hyphenation and positioning
HYR: CMYK imagery – too "red, blue, etc"; overall bluish (color casts)
Spot colors – derived spots are called out – to be another pass on press
NOTE: problem with judging duotones
CT: CMYK, duotones, fidelity/sharpness – color shifts, density, sharpness, detail
Spot colors – correct color break, "isn't that blue line supposed to be red"
Type – spelling, line wrap, font choice
RH: CMYK imagery – levels of contrast

2. What corrections pertain to the following parts of a FPO proof: CMYK imagery, spot colors, duotones, type, image fidelity/sharpness.
EG: FPO images are used only to show relative position and subject matter! No corrections are done to them.
HYR: check for missing elements; spaces in text; alignment of objects; check design feasibility

CT: CMYK, duotones, fidelity/sharpness – color shifts, density, sharpness, detail
Spot colors – correct color break, "isn't that blue line supposed to be red"
Type – spelling, line wrap, font choice

Questionnaire Two

Section One: *Resolution*

1. What levels of text resolution are common on your proofing systems?

QQ: laser b/w 400dpi; Iris – antialiased text 1270 1bit--->300 8bit--->press sheet of 1270dpi

Section Two: *Sharpness*

1. which types of your proofing technologies affect the sharpness of text and dis play type?
See scanned samples

Section Three: *Font Access*

1. Where are fonts for your proofing system stored?

QQ: almost always downloaded from a Mac.

2. Who needs to have them?

QQ: procedure: check if in file: if YES-->check flow of text
if NO-->retrieve fonts asap

3. Are fonts needed after the file is saved n X format?
QQ: font images are saved in postscript files

Questionnaire Three

Section One: *Process Color Imagery*

1. What technical factors directly affect process color imagery?: file format, RIP, here the image information is processed (by Quark, PS, etc.)

QQ: File formats: Single file EPS – pict preview and clipping path capable
TIFF – no compression
DCS – used only for 5+ colors; takes up more disk space
CMYK editing in PS
2x line screen rule of thumb works well (1.5 to 2.0 in general)
RIP does seps due to its compliance with front end of GTO-DI
Speed considerations: Quark is fastest generally; Pagemaker is tripped by Laserwriter 8

HYR: trapping by program--in house or at service bureaus

EG: We have not seen to many differences in rips for imagery. Most of the differences occur after the rip and are caused by using different output devices, different screen angles, different x-curves. There are a few differences in software applications that cause jaggie edges such as CT on CT. We have seen this in scitex applications.

CT: Subject matter – dark, light, contrast, shadow detail, color range, patterning, color saturation
Scan quality – drum (PMT) scanner vs. flatbed (ccd) scanner, operator training;
Scan decisions – RGB, GCR, UCR, UCA
File format should not be a factor
Operator skill when working with the file
RIP should not be a factor unless screen angles are off
Imagesetter accuracy, repeatability, and "quality"

2. What factors affect a digital proofing system's image consistency?

QQ: Iris System: self calibration tests before every print
Every 1–2hrs: flush of system and test of registration
Humidity: paper loading errors with dry air
Initial callibration to press is crucial: thereafter not much drifting in image quality.

HYR: voltage fluctuations; stock's moisture content; life cycle of chemicals; toner cartridge life; fuser lifecycle; proper maintenance

EG: The Approval system is kept in a climate controlled area. Temperature fluctuations would affect consistency. Emulsion batch for materials is important Recalibration is needed when material is changed.
(no chemicals involved)

CT: Kodak Approval system – is very stable; only question is callibration

3. How can process color imagery be altered by different proofing systems—is dot gain simulated on halftone capable proofers, is registration ever a problem?

QQ: images can be altered by upgrades in software-->when used with consistent hardware

EG: Approval system – different curves can be built for different press applications. Much the same as x-curves or plotting curves for scanners and plotters.
Different substrates can also be used. Registration is never a problem.

CT: Kodak Approval – registration is never a problem; dot gain is part of the standard callibration procedure

* * * WL: Limitations of DTP imaging. Thin lines may show pixelled edges on press but not on proof.

Section Two: *CMYK*

1. How are the dyes or toner particles in a proofer different than conventional printing inks and pigments—do they directly affect image sharpness or fidelity?

QQ: Iris: dyes generally produce more saturated colors than toner
With software, one can purposefully contaminate original solid ink density of a color with other process colors to simulate printing ink pigments.

EG: Digital proofers do not have to contend with all the possible variations and variables that ink on paper presents (double, slur, wet vs. dry trapping, offset, absorption, etc.)

The dot formed by a digital proofer will always be perfectly shaped therefore sharpness and fidelity will always be superior on the proof.

CT: Ink vs. Dye – Digital proofer is by its nature sharper and truer to the image than ink on paper. These differences are compensated for in the calibration procedure.

2. Which types of your proofing equipment display more noticeable differences in color gamut?

QQ: Ink jet: widest color gamut

Dyesub: next widest

Thermal wax: farther behind, much narrower color gamut..

HYR: Xerox Majestic: blue/greens are tough; grays are tough; pastels are tough

CT: Dye sub is generally too far out of the press gamut to be useful for high end work. All proofers are calibrated to the press. Monitor to anything is the largest difference. Actual ink on paper is where shifts are likely to occur.

Section Three: *Duotones, etc.*

1. How are duotones, etc. affected by the CMYK process?

QQ: set up in PS – duotone control with CMYK ink or: with a black and white image in Quark, a "foreground color" is set to be the second duotone color. NOTE: foreground colors in Quark replace the gray scale of an image. This Quark process saves disk space in comparison to Photoshop.

EG: We create them using separate channels for each color Ex: cyan = pms 287; black = black 287 is dominate; black starts @ 30%

CT: They are NOT. All t-tones begin as monotone/greyscale images Other colors are then applied to the image as required by the desired effect.

2. Which of your proofing systems will display these (duotones, etc.) more effectively?

CT: Since most t-tones require special inks; we use matchprint with a limited selection of "special" colors to create simulations of the actual t-tone.

Section Four: *Spot Color Accuracy*

1. How accurate are spot colors on digital proofs?

QQ: not good; write on proof, "to match PMS. . ."; blues are most off, 1–2 steps off on Pantone guide.

RH: not at all in house with Canon/EFI; check for pantone book comparison; blues and oranges off the most; greens are close and off; reds are closest; Call out/attach a PMS swatch to proof

HYR: off generally; suggested to run a 5th, 6th, or 7th color(s) on press

EG: Not Available – 100% of a process color could be used by the file would be bogus.

CT: spots are poor on all proofing systems.

3. Pantone Color Matching – If spot colors are not rendered properly, are PMS swatches attached to a proof?

EG: NO. In most cases a final proof is made after films are generated This proof would be either a 3M Matchprint with special color, or a DuPont Cromalin with special toner mixed to specs.

CT: Yes – also "drawdowns" are sometimes ordered and supplied.

Section Five: *Computer Illustration and Blends*

1. Being comprised of simulated spot colors, how accurately are blends shown by different proofing systems?

QQ: most files/illustrations are converted to CMYK equivalents: it's also possible to call out another spot color as another hit on the press.
– blending of spot colors is not supported by Post Script
–Illustrator has CMYK equivalents pre-attached to all custom colors

EG: Some blends and vignettes show a stepped or hard-break pattern that does not occur when going to film. Color accuracy for CMYK blends is good. Smoothness of the vignette is dependent on the x-curve output chosen.

CT: No more accurately than solid spot colors; all we show as either special matchprint colors or as CMYK equivalents.

Section Six: *Viewing Conditions*

1. Where should all proofs be viewed?

QQ: 5000k lighting booth to compare to soft proof; 5000k lit room.
RH: light room with same light box as printer has; similar size room for light spread; possible combination of lightroom and office?
HYR: available light; mostly fluorescent due to most clients ending views of printed piece will be in office conditions; however, proper 5000k lighting should always be used when evaluating a press run.
EG: 5000k ONLY! : NEUTRAL GRAY SURROUND
CT: in a proper light booth only

2. What visually influential factors arise when viewing proofs under the correct lighting?
QQ: adaptation of eyes.
RH: wake up time; considerations as to which colors in composition have to be pleasing, and which need to be accurate.

EG: All these take some part in viewing proofs. Most important is avoiding metamerism. Always view under ANSI PH 2.30-1985 5000k lighting conditions.
CT: Environment and surround should be neutral. After that it is up to the quality of the presentation and professionalism of the viewer.

Questionnaire Four: Substrates

Section One: *Plain Paper Pros and Cons*

1. Which of your proofing systems use plain paper?

QQ: Iris: will use plain paper of a reasonable thickness and stiffness; trouble loading with dry air
NOTE: on coated stocks, ink jet dot (of dye) moves a little on surface of paper before absorbed. On uncoated stocks, ink jet dot absorbed quickly, but spreads a little once past the surface of the paper. Ideally, the ink jet

dot should absorb instantaneously and not spread once past the surface of a substrate.

HYR: LaserMaster b/w; HPDeskjet; Xerox Majestic 5750

EG: the Approval System uses any substrate within the confines of thickness and flexibility. Cromalin as well.

2. How can plain paper affect colors?

QQ: less intense colors appear on plain uncoated papers (less saturation; hue can shift slightly); softened images result.

EG: Substrate will always affect the color of an image. (most noticeably in the highlight and 1/4 tone where the image is mostly substrate). The reflectance of a paper will also affect the brightness of the subject. Many times the substrate that proofs are made on is too good. The proof looks great, the press sheet is good or not so good–depending on the paper.

HYR: chosen paper changes imagery most noticeably when coated and uncoated substrates are compared;
NOTE: compare opacity/thickness of toner particles to opacity of printing inks.

WL: color blending, lower screen value, pluging in higher screen values

3. What are some advantages of plain/chosen paper proofs?

QQ: good for showing client a design on chosen paper to see if any last minute design changes are needed.

EG: closer representation to the press sheet.

HYR: customer's choice to see a representational "final"

RH: general idea of finished product

WL: better idea of final looks; still subjective; stillnot ink on paper

4. What are some disadvantages of plain/chosen paper proofs?

QQ: they are not for any sort of color matching or of any prepress value

HYR: paper grain and textures must be debated over with customer; can paper be run through a prelim proofer with the grain in the proper direction? will it jam in Xerox or pre-proofer?

RH: tough to get art directors to approve plain paper proofs because they don't have that high gloss, finished look that a conventional proof may have;

the subject matter may be hard to judge in regards to the paper if proofing process is affected by the surface of the substrate.

EG: some stocks (depending on thickness and flexibility) can not be used.

Questionnaire Five

Section One: *Fidelity*

1. How is image fidelity affected by proofing substrates?

EG: The more coarse the surface the less sharpness. Woven paper or textured stock reduces sharpness.

2. How does resolution affect image quality in regards to proofing process?

EG: The higher the res the better the image. Too high a res will make printing time prohibitive.

3. How does proofing process affect image fidelity, saturation, sharpness, color balance, and hue.

HYR: on the Majestic: thickness of toner with no undercolor removal initiates piling and chipping of toner.

4. How does stochastic screening resolution affect image quality?

EG: We have had no problem proofing our stochastic output.

Questionnaire Six

Section One: *Open Loop vs. Closed Loop Systems*

1. Which proofing mechanisms are considered worthy of producing contract proofs in a closed loop system?

HYR: IRIS and Approval

WL: use of system provider has; Iris is OK for a proof directly ahead of the final contract proof
EG: EK Contract; EK Approval; DuPont Cromalin

2. Which proofing systems are considered worthy of producing contract proofs in an open loop?

HYR: still some credibility in Iris proofs; Kodak Approval
WL: Iris and Approval w/out spot considerations
EG: same as previous question

3. When should a halftone dot proof be required?—closed or open loop?

HYR: Whenever a proof is going to press via films.
EG: we require it at all times. you may make a closed loop system work (w/ contone) but only for certain customers—those who accept a certain type of quality.

Section Two: *The Confidence Factor*

1. In your contract proofing system, does the same mechanism image both proofs and films? —if not, which mechanism produces which?

EG: DuPont Cromalin - yes; mathcprint - yes;
EK Approval - no-->proof=Approval engine Film=plotter

2. Are there advantages or disadv. to either of the previous question's system methodologies?

EG: Approval - advantage is there is no film necessary for the proof
disadvantage is the small size - no larger than tabloid
3M + DuPont - advantage is large format up to 25 x 38
disadvantage - must output film then complete second step of proofing.

3. Can conventional proofs be compared to digital contract proofs?

HYR: When comparing both: conventional seems to be sharp and glossy/saturated due to coatings and lamination; contract digital proofs such as the Iris are not as of high a resolution + they look dull due to no lamination which makes them appear closer to a final product (coating wise).

WL: not in the same job; if experimentation with the quality of digital vs. conventional is present, then comparisons may be executed – but still not within the same job.

EG: yes but there are differences as there are differences between all proofing systems.

4. Is it worth the cost to have both produced? Why?

HYR: pre-proofs always compared to contract proof (whether or not contract proof is digital) in case client likes some features (color, saturation, qualities) of the preproof – to be artificially added to the contract proof by means of digital manipulation.

RH: usually a contract proof is best produced either digitally OR conventionally; if one breaks and the other is used in its place, the image differences introduce confusion to the judgement process; above all else – proof must match press sheet.

EG: If the purpose is to check accuracy of output: no, you would not produce both. The digital output is calibrated and checked at regular intervals to insure repeatability. If the purpose is to reduce cost: maybe. It depends on size, quantity, substrate, what employees are making the proofs, etc.

Appendix C

Chapter Six Questionnaire Compilation

Representatives:

Kodak:	Approval, Wick McCaleb
Fuji:	FirstLook, Richard Black
IRIS:	IRIS proofer series, Stan Rosen
3M:	Rainbow, Nick Patricci
Optronics:	Intelliproof, Andy Katz
DuPont:	Digital Waterproof, Martin Redding

1. What do you consider to be the definition of a closed loop system?

DuPont
Ultimate definition–trade shop is producing a proof for a specific printer with the following: same level of standardization by trade shop and printer for calibration, viewing conditions, file formats, imagesetter, page layout systems/applications

Optronics
Ultimate definition–With a strong relationship to the printer, the trade shop controls standards regarding film output, press attributes, scanning, proofing. In a closed loop system, print buyers and art directors are more likely to accept any type of contract proof. NOTE: printer does not have to be geographically near trade shop—only a strong working relationship needs to exist between the two.

3M
Opposite of SWOP. Trade shop knows where the end press will be—and its attributes. It is a press match versus an industry standard. A common specific target versus a common target.

IRIS – Scitex
One needs to standardize color management. Color management system has to be a good predictor. Prepress and printer must know what client is looking for.

Automatic monitoring of all systems.
Ultimate definition: A closed loop system includes known criteria, measured tolerances, adjustments must be able to be made within those tolerances.
Phrase, "garbage in, garbage out."

Fuji
Ideally, the printer has in-plant control of digital data and prepress. All prepress and printing should be internal.

Kodak
Ultimate definition: printer works with same trade shop for every job.
Other considerations: in a closed loop system, one knows how big variables may become, how often they tend to arise, system to system variables are all noted and controlled to best ability.

2. What proof to press variables arise in a closed loop system?

DuPont
Scanning operator and software changes, upgrading of usual page make-up program (these upgrades may handle text and color differently)

Optronics
In regards to Scanning: no manual adjustments should occur; properly calibrated software usually adjusts for dot gain. Separation software: should not adjust colors, but usually do.
In regards to Proofing: substrate of the proof is a variable, registration of proof
In regards to Press: colorimetry of press ink gamut as compared to such of proofing dye color gamut; substrate on press in comparison to substrate of proof

3M
Four areas:
   a. Color Match the colorimetric characteristics of press ink and proof dyes
   b. Tone Response – high dot gain, substrates, printing process

c. Appearance – gorgeous prints but not a match?
d. Effort of press upkeep and output

In regards to fourth area: keep dot gain differences between press runs and dot gain of different inks under a carefull watch; get a target and keep the press there; work backwards with Print Analysis.

IRIS – Scitex

Five areas:

a. standards must be the same
b. measurements
c. temperature in processor
d. variables of printer
e. variables of print buyer's MIND

Fuji

Data handling: there is less data travelling from point to point. Less points to travel to. Media. File formats. Standard procedures.

Kodak

One must control everything (but at least they have the option/ability to).

Several areas:

a. scanning
b. retouching
c. rescans
d. calibration and linearization of all systems
e. page make-up: moving elements on a page affects how the colors of all elements appear.
f. changes in viewer opinion of object colors.
g. overprints from 2 sets of process dyes (with the same two colors) may be different even when they are both printed at the same D-max!

3. What do you consider to be the definition of an open loop system?

DuPont

Ultimate Definition–trade shop's only goal is to produce a good looking proof regardless of printing system

Optronics

Ultimate definition–trade shop accepts and provides input from anywhere and output to anywhere respectively. SWOP and SNAP standards are followed. High quality, pleasing color is valued to a greater extent than accurate color.

3M

SWOP – industry standards. No specific ending printer.

IRIS – Scitex

All systems of prepress and press monitored manually. This makes more room for human error. Analogy: auto heat on a film processor set for one set of press attributes versus a control strip for film processor for temperature determination.

Fuji

An open loop system involves the taking of data from someone; printers without prepress, all prepress trade shops.

Kodak

Printer receives films and digital information from anyone. Two vendors work may be on one plate!

4. What proof to press variables arise in an open loop system?

DuPont

press and its attributes (dot gain, ink trapping), proofing system, file formats, film, and imagesetter linearization

Optronics

In regards to Scanning: no manual adjustments should occur; properly calibrated software usually adjusts for dot gain. Separation software: should not adjust colors, but usually do.

In regards to Proofing: substrate of the proof is a variable, registration of proof

In regards to Press: colorimetry of press ink gamut as compared to such of proofing dye color gamut; substrate on press in comparison to substrate of proof; dot gain and other press attributes such as ink trapping.

PLUS

In regards to Turn around time: shorter means less accurate and more pleasing color.

3M

Same as question 2.

PLUS

Do printers adhere to SWOP or SNAP

IRIS – Scitex

Process control with hand measurements.

Fuji

Several areas:

a. What constitutes a dot.

b. Do not know which ink set—there are 50 to 60 magentas which match SWOP!

c. No concise standards—just industry-wide ones such as SWOP.

Kodak

Printers may wish to may films by themselves, even after they receive films from a trade shop. Press gain, ink trap, differences in proofing standards between trade shops.

5. Depending upon the economics of the job at hand, which currently marketed digital

proofers do you consider contract viable in a closed loop system?

DuPont

HIGHEND printing applications: go with analog or Approval system when educated about digital proofing

MIDRANGE printing applications: 30 to 40% educated users proof with IRIS and Digital Waterproof (both continuous inkjet/continuous tone)

LOWEND printing applications: 60 to70% educated users proof with Rainbow and other dye sublimation proofers (applications include newspaper to bulk mailers)

Optronics

ANYTHING in theory is fair game depending upon agreement. Rainbow, IRIS, Intelliproof, Approval: the major important factor is the agreement between customer and printer.

3M

To answer, one must define the meaning of the phrase "contract proof". Agreement between creative, prepress, and printer on proof quality in regards to color accuracy, etc. Decide how many printing process attributes the proof should represent. The word "quality" raises questions such as: match press or industry wide standards?, good looking?, market specific quality?, how good it looks OR how well it does the job?, callibratable?, repeatable?, maintenance?

IRIS – Scitex

One must consider the following: What are the financial benefits to print buyers and manufacturers.

Ideally: a proof is to mimic as many printing process attributes as possible.

Fuji

Depends on what a contract proof is defined as. Used to be that a contract proof had to have dots and multiple layers. Vendors used to dictate which proofing sys-

tem would be used—NOW, the customer does so.
Personally, interviewee would trust Approval.

Kodak
A definition of, "contract proof" must be acquired to answer this.
Personally, interviewee trusts Rainbow/IRIS/Approval

6. Depending upon the economics of the job at hand, which currently marketed digital proofers do you consider contract viable in an open loop system?

DuPont
Same as question 5.

Optronics
Same as question 5.

3M
Same as question 5.

IRIS – Scitex
Same as question 5.

Fuji
Same as question 5.

Kodak
Same as question 5.
PLUS
It is important to note that no matter what is agreed upon as the definition of contract, more variables arise in the open loop. Therefore a more accurate proof is needed.

7. Do you think that comparing digital and conventional proofs on a single job causes more confusion than it does good?

DuPont

There is usually not enough time to use both. By definition, digital and analog systems are too different.

Within a DIGITAL workflow, the following options for digital proofing are available:

a. check as final preproof
b. use as contract proof—digital proofers can fingerprint a press

Optronics

Yes—mental adjustment that go on can be confusing between what each separate viewer is used to. Adjustments which arise occur within a triangular relationship of *press* TO *digital proof* TO *analog proof.*

3M

Depends upon proofing systems at hand.

Mainly – use the proper technology where it applies in the workflow.

IRIS – Scitex

The point to this question is the client will accept whatever type of proof the trade shop and printer give them (eventually). They have no choice. This would hint that the idea of comparison is obsolete. Education is the key. Force the client to use the newest technology that the providers have.

Fuji

Yes—more technologies present greater confusion. One may have 3 or more technologies on one job is customer dictates what to match. Provider may see Approval, IRIS, and Rainbow on one job if time/funding gets tight.

Kodak

Yes—it jeopardizes the ability of one to properly judge proof to press changes. Two systems are harder to judge than one!

8. How many viewers of a contract proof do you consider reasonable?

DuPont

Three options:

a. one sign off person
b. print buyer signs and brings to art director
c. art director sees, then print buyer signs

Note that options b and c depend on the amount of trust and working experience that exists between the art director and print buyer.

Optronics

Dependent upon the following:

a. Selling color in house or out of house?
b. Are sales person, art director and /or print buyer knowledgeable?
c. Do they have knowledge regarding mental compensation of proof to press?
d. More people means more differences of opinion—the fewer the better.

3M

One.

Fuji

Today, anyone approves. In the past, one person. This person had exceptional knowledge about how the proof related to the press.

Kodak

Depends on what you are looking for.

One person is optimum.

Art director signs off on designs and general color only.

Print buyer has the ultimate signing authority.

9. Would you consider comparing the two on a single job a method of swaying the print buyer towards trusting digital contract proofs? If not, why?

Optronics
Yes—recommended to use both proofing mechanisms for comparison until print buyer and/or art director will sign on both—>then shift to digital only.

3M
Questionable: Do color match between systems? In which type of workflow? Used in a combined workflow?

Kodak
Yes if the match between the two is close. A closer match promotes confidence. A worse match demotes confidence on the switch to completely digital proofing.
Maybe not:
If switching to digital proofers: greater differences between conventional and digital demotes trust. Likewise, the opposite may also occur for promoting trust.

10. What are the reasons behind matching the standards of your digital and conventional contract proofing systems? [if applicable]

DuPont
First it increases the element of trust presented between art director/print buyer AND trade shop/printer
Secondly, since both are analog and digital versions are being used, it is a marketing advantage to the manufacturer.

Optronics
The only reason of matching both systems (digital and analog, both from same manufacturer) is for marketing advantages.

3M
In a combined digital and conventional proofing workflow, trade shop and printer are trying to match a common target. Reasons for a dual technology workflow: unless whole process is CTP, we still need to verify imaging and processing of film/variables of imagesetter.

IRIS – Scitex
Fingerprint the press with a digital proof.

Fuji
Helps with the process of redefining what contract proofs are: helps explain disadv. and adv. of both technologies.

Kodak
Target and effort is there, but this is an impossible task due to differing gamuts of dye and pigment.
Good for goal of matching test target when switching to digital.

11. What (other) information about *your* digital proofing system would you consider essential in the purpose of convincing print buyers to trust digital contract proofing?

DuPont
Amounts of acceptance in industry with MIDRANGE printing applications is 30 to 40% at the end of 1995 which is expected to rise to 50 to 60% by the end of 1996.

Optronics
The Intelliproof provides extremely fine adjustments of dot gain for compensations on press; has the same RIP and screen patterns for proofs and films/plates.

IRIS – Scitex
Frees labor, proof is closer to the original, straight from files. These facts versus the large amounts of time and materials needed for conventional proofing systems. In conventional systems, films are often made just to proof—not for production where they should be used once.

Fuji
Fast, inexpensive, gamut has been made to match other Fuji proofing systems, ideal for remote proofing.
The Fuji Firstlook keeps the software the same while making mechanical adjust-

ment in proofer engine to calibrate to a new media VS. calibrating software to changes in media.

Kodak

Approval allows one to proof as sharp as wanted—>with adjustment made for more press gain, one sees less sharpness—>with adjustment made for less press gain, one sees more sharpness.

"True color management programs work only on halftone proofers." This is due to only two variables of D-max and dot size/simulated press gain.

Double the acceptance from 1995 to 1996.

12. Generally speaking, what other information do you consider essential in this purpose?

DuPont

Remote proofing option.

However remote proofing convenience must be questioned regarding the following:

Is the internet capable of high speed transfers at low costs—no

Time to economical data transfer—3 to 4 years

Sheer volume of files require T1 to T3 connections or fiber optic networks

Current T3 max throughput is 3MB per second

Optronics

Digital proofing ability to fingerprint press. Color accuracy, screening accuracy, throughput/turnaround time, savings in cost [if applicable].

3M

One may shift the control of color to the client. Not left to local prepress providers which may be untrustworthy. Faster turnaround times.

IRIS – Scitex

Cheaper cost of materials. Faster turnaround times give client more time for design adjustments.

Education! An approach to educating the client includes the following:

a. find out the objections of the print buyers and art directors: mental
b. solve with scenarios
c. integrate digital proofing
d. Education should involve information about remote proofing.

Fuji

Speed.

Kodak

See the handwriting on the wall: you have to stick to the leading edge to stay profitable; CTP around the corner.

Also, larger format proofers are becoming available for imposition only (not color accuracy or quality).

Remote proofing with the following considerations:

Questionable repeatability with the lower quality proofers—these are more often the best suited to remote proofing.

Cost of proofer to be used as a remote proofer.

Cost for how many sites?

Remote proofing is currently limited to, and most often considered best for, conceptual proofing only.

Wire speed.

Satellite systems are very expensive. Often only used between two branches of the same company <—this factor promotes the use of more costly remote proofers due to known standards and printing attributes.

13. What factors do you think would *dissuade* print buyers from trusting digital contract proofs?

DuPont

Most print buyers are used to halftone dots—if a proof lacks them, they will use it. Digital proofer halftone dots are different than imagesetter dots (except Intelliproof). Changes in data are possible with all color computers throughout a digital workflow.

Optronics

Not enough digital proofers out there yet.

Differences in regards to how many proof attributes mimic press attributes and printing process results.

Screening—ability to view possible moiré.

3M

Bad experiences have lasting effects. Confusion/lack of education. Print buyer and art director may have wrong expectations or too great of ones. There is confusion created by the amount of products available to clients. Many clients already have a mental picture of what a proof should look like, and will not sway from that picture easily.

IRIS – Scitex

Again, a lack of education is the big deterrent.

Analogy: All new proofing systems were originally not accepted. Cromalins were not accepted because they were not separable like color keys. The key was education about the Cromalin system.

Fuji

Biggest factor is a lack of education.

Other factors include: color consistency, 6 technologies for industry to figure out nuances of. Possibility of not being faster than conventional systems because of current integration problems and low level of some of these technologies. Is digital proofing cheaper? Is storage of data cheaper than cost and storage of film?

Kodak

Doubt around integrity and non-corruption of electronic data.

Can reuse films in comparison to reloading data which may have been corrupted.

Total security of working with the familiar.

General Information from Kodak's Wick McCaleb

Levels of proofing:

a. conceptual
b. intermediate—in house by prepress provider
c. contract

Variables in proofing workflow efficiency:

a. number of mark-ups is dependent on customer habits:
   is first contract option proof almost always turned down and corrected?

Disadvantages to Contone digital proofers:

Contone proofs are most likely to change from day to day. There may be as much as a 50% change in neutrals to highlight.

e.g. 1% shift in 5% dot means a 20% change.

Contone proofs have infinite variables due to dithering.

Advantages to Halftone digital proofers:

No dithering. Approval always prints a D-max dot of the process color dyes just like the press does. This means there are only two variables: dot size and D-max maximum.

Important factors to consider in regards to the definitions of Open and Closed Loops.

Applicable to both Open and Closed Loop Systems:

Confidence between prepress trade shop and printer depending on past experiences of proof comparisons (digital to digital OR digital to conventional)

Applicable more often to Open Loop System:
Comparisons of 2 proofing systems by printer when Proof A (from prepress) is a different proofing system than Proof B (made by printer).

Applicable to both Open and Closed Loop Systems:
Are trade shop proofs to be received by multiple printers?

Acceptance of Digital Proofing Diagram

LEVEL 1: includes confidence between art director and /or print buyer AND prepress trade shop [there are more reasons to trust digital proofing in a closed loop system than in an open loop system where more variables are present].

Mention which variables always appear in both systems.

LEVEL 2: Open Loop vs. Closed Loop system boundaries: includes confidence between trade shop and printer based on past working experiences (any?) AND standard procedures regarding what trade shop hands printer AND whether gravure or offset printing.
Mention standard procedures between trade shop and printer—SEE below.

Considerations for Standard Procedures:
What does trade shop send printer?

a. Films and digital proof?
b. Files and digital proof for CTP system?

What does printer do with goods from trade shop?

a. Do they reproof conventionally and compare?
   Note the OBVIOUS: All proofing systems are different.
b. Do they proof files with same digital proofer?
c. Do they make films with out proofs depending
   on whether or not they have worked with the trade
   shop before—>comfort factor.